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ORIGINAL ARTICLES

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EDITOR OF THE MONTH

ARTHUR L. WATKINS, M.D.

Boston, Mass.

Printed in U.S.A.

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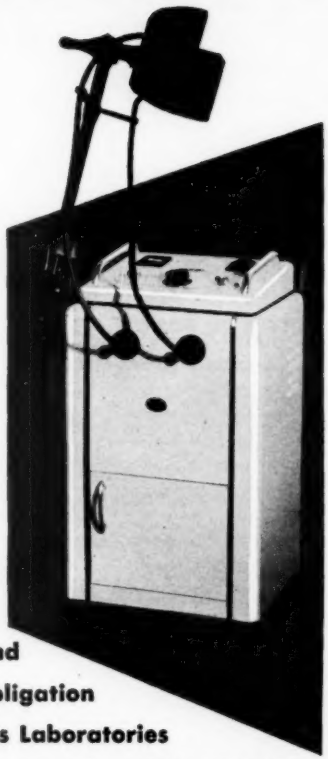

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Council on Medical Education and Hospitals of the American Medical Association

Name and Location of School	Medical Director and Technical Director	Entrance Requirements [1]	Duration of Course	Classes Begin	Maximum Enrolment	Tuition	Certificate, Diploma, Degree
Medical Department — U. S. Army							
(Address all inquiries to the Office of the Surgeon General, Department of the Army, Washington 25, D. C.)							
Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston (San Antonio), Texas	J. E. Tate, Lt. Col., M.C. Agnes P. Snyder, Maj., WMSC	b-e	44 wks.	Oct	20	None	Certificate
Fitzsimons Army Hospital, Denver	H. B. Luscombe, Col., M.C. Olena M. Cole, Maj., WMSC	Affiliated with Medical Field Service School					
Letterman Army Hospital, San Francisco, California	A. E. White, Col. M.C. Emma Harr, Maj., WMSC	Affiliated with the Medical Field Service School					
Walter Reed Army Hospital, Washington, D. C.	J. H. Kuitert, Lt. Col., M.C. Brunetta Kuehlthau, Maj., WMSC	Affiliated with Medical Field Service School					
Nonfederal							
Childrens Hospital, Los Angeles*	S. S. Matthews, M.D. Mrs. Mary J. Dodge	a-b-d	14 mos.	Sept	14	$300	Cert. or Degree
College of Medical Evangelists, Los Angeles*	F. B. Moor, M.D. R. Wm. Berdan	a-b-c	15 mos.	Sept	16	$300	Cert. or Degree
University of Southern California, Los Angeles*	C. L. Lowman, M.D. Charlotte W. Anderson	a-b-d f	14 mos 4 yrs.	Sept FebSept	16 6	Univer. Univer.	Certificate Cert. & Degree
University of California School of Medicine, San Francisco*	Lucile Eising, M.D. Margery L. Wagner	d	12 mos.	Sept	16	$220[2]	Cert. or Degree
Stanford University, Stanford University, Calif.*	W. H. Northway, M.D. Lucille Daniels	a-d-e f	12 mos. 4 yrs.	Varies Sept	29 16	$690 $230 qr.	Certificate Degree
University of Colorado Medical Center, Denver*	Harold Dinken, M.D. Mary Lawrence	a-b-d	12 mos.	Sept	12	$308[2]	Cert. or Degree
Northwestern University Medical School, Chicago	E. D. W. Hauser, M.D. Gertrude Beard	a-b-d	12 mos.	Oct	16	$450	Certificate
State University of Iowa College of Medicine, Iowa City*	W. D. Paul, M.D. Olive C. Farr	e	12 mos.	Sept	20	$200	Certificate
University of Kansas Medical Center, Kansas City, Kan.*	D. L. Rose, M.D. Ruth G. Monteith	d f	12 mos. 4 yrs.	FebSept FebSept	3 9	$40[2] $40[2]	Certificate Degree
Simmons College, Boston	W. T. Green, M.D. Shirley M. Cogland	a-e f	16 mos. 4½ yrs.	Sept Sept	24	College	Diploma Degree
Boston University College of Physical Education for Women, Sargent College, Cambridge, Mass.	Kenneth Christophe, M.D. Adelaide L. McGarrett	c-d-e-f	1-2-4 yrs.	Sept	30	Univer.	Cert. or Degree
Bouve-Boston School of Physical Education, Medford, Mass.	Howard Moore, M.D. Constance K. Greene	f	4 yrs.	Sept	16	$850	Dipl. & Degree
University of Minnesota, Minneapolis*	F. J. Kottke, M.D. Ruby Green Overmann	c	2 yrs.	Sept	30	$126	Degree
Mayo Clinic, Rochester, Minn.*	E. C. Elkins, M.D. Harry Keown	a-b-c	2 yrs.	Sept	38	$250	Certificate
St. Louis University, Division of Health and Hospital Services, St. Louis[4]	A. J. Kotkis, M.D. Sister Mary Imelda	f	4 yrs.	JanSept	12	$175 Semes.	Degree
Washington University School of Medicine, St. Louis*	Sedgwick Mead, M.D. Beatrice F. Schulz	c	2 yrs.	Sept	16	$450 1st yr. $325 2d yr.	Degree
Albany Hospital, Albany, N. Y.	J. W. Ghormley, M.D. Catharine Graham	a-b-d f	12 mos. 4 yrs.	Sept Sept	6	$300 $500	Certificate Degree
Columbia University College of Physicians and Surgeons, New York City*	W. B. Snow, M.D. Floy L. Pinkerton	a-c-e	1-2 yrs.	Sept	50	$680 (1 yr.) $1,200 (2 yrs.)	Cert. or Degree
New York University School of Education, New York City*	G. G. Deaver, M.D. Elizabeth C. Addoms	a (+1 yr. coll.) b-d	12 mos.	Sept	40	$615	Cert. & Degree
Duke University, Durham, N. C.*	L. D. Baker, M.D. Helen Kaiser	a-b-d	15 mos.	Oct	12	$350	Certificate
Cleveland Clinic Hospital, Cleveland*	Walter J. Zeiter, M.D. Mildred Heap	a-b-c	12 mos.	Oct	12	$200	Diploma
D. T. Watson School of Physical Therapy, Leetsdale, Pa.*	Jessie Wright, M.D. Kathryn Kelley	a-b-d	12 mos.	Oct	25	$300	Diploma
Division of Physical Therapy of the School of Auxiliary Medical Services of the University of Pennsylvania, Philadelphia*	G. M. Piersol, M.D. Dorothy E. Baethke	e f	12 mos. 4 yrs.	FebSept Sept	32 40	$600 $600	Certificate Cert. & Degree
University of Texas School of Medicine, Galveston*	G. W. N. Eggers, M.D. Ruby Decker	a-b-d	12 mos.	Jan	8	$148[2]	Cert. or Degree
Hermann Hospital, Houston, Texas*	O. O. Selke, Jr., M.D. Mary Elizabeth Kolb	a-b-d	12 mos.	Oct	15	$300	Certificate
Baruch Center of Physical Medicine and Rehabilitation, Medical College of Virginia, Richmond*	W. J. Lee, M.D. Susanne Hirt	a-b-d f	12 mos. 4 yrs.	Sept Sept	52	$300[3]	Diploma Degree
University of Wisconsin Medical School, Madison*	H. D. Bouman, M.D. Margaret A. Kohli	a-b-d f	12 mos. 4 yrs.	Sept FebSept	22 20	$60 Semes.[3]	Certificate Cert. & Degree

** Reprinted in part J. A. M. A. 146:197 (May 12) 1951.

1. Courses are so arranged that any of the entrance requirements will qualify students for training. a = Graduation from accredited school of nursing; b = Graduation from accredited school of physical education; c = Two years of college with science courses; d = Three years of college with science courses; e = Four years of college with science courses; f = High school graduation.

2. Nonresidents charged additional fee.

* Male as well as female students admitted.

Southern Medical Association Meeting

Section on Physical Medicine and Rehabilitation

November 5, 1951

Dallas, Texas

OFFICERS

Chairman — **E. M. Smith, Washington, D. C.**
Vice-Chairman — **A. Ray Dawson, Richmond, Va.**
Secretary — **Sedgwick Mead, St. Louis, Mo.**

Presentations limited to twenty minutes with ten minutes for discussion — thirty-minute periods.

Monday, November 5, 1951, 1:30 p. m.

1. **Chairman's Address. Physical Medicine in the Management of Peripheral Nerve Injuries.**
   E. M. SMITH, Chief, Physical Medicine, Consultants Division, Department of the Army, Office of the Surgeon General, Washington 25, D. C.

2. **Electromyography in the Practice of Physical Medicine and Rehabilitation.**
   JAMES G. GOLSETH, Medical Director, Pasadena Clinic of Physical Medicine, 1060 East Green Street, Pasadena 1, California.
   Discussion opened by Sedgwick Mead, St. Louis, Mo.

3. **Physical Treatment of Fractures.**
   EDWARD M. KRUSEN, JR., Director of Physical Medicine, Baylor University Hospital, Dallas 1, Texas.
   Discussion opened by Lee T. Ford, St. Louis, Mo.

INTERMISSION

4. **Present Status of Use of Ultrasonic Energy in Physical Medicine.**
   FRANK H. KRUSEN, Section on Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, Minnesota.

5. **The Role of Occupational Therapy in the Physical Medicine Management of Physical Disabilities.**
   C. D. SHIELDS, et al., Chief, Physical Medicine Service, Brooke Army Medical Center, Fort Sam Houston, Texas.
   Discussion opened by A. Ray Dawson, Richmond, Virginia.

6. **Post-Injection Paralysis.**
   G. D. WILSON and W. F. HILLIER, Asheville, North Carolina.
   Discussion opened by E. M. Smith, Washington, D. C.

7. **Some Considerations Regarding Long-Term Rehabilitation of Brain Injuries.**
   BEN L. BOYNTON, Chief, Physical Medicine Rehabilitation Service, and LEWIS A. LEAVITT, Assistant Chief, Physical Medicine and Rehabilitation Service, Veterans Administration Hospital, Houston 4, Texas.
   Discussion opened by Raoul C. Psaki, Fort Sam Houston, Texas.

8. **Conservative Treatment of Degenerative Arthritis of the Knee.**
   OSCAR O. SELKE, JR., Department of Physical Medicine, Hermann Hospital, Houston 5, Texas.

Election of Officers

THE FIRST JOHN STANLEY COULTER MEMORIAL LECTURE *

KRISTIAN G. HANSSON, M.D.

NEW YORK

As an expression of devotion to their departed colleague and leader, the American Congress of Physical Medicine established a fund to provide for a series of John Stanley Coulter Memorial Lectures, the first of which was delivered in the form of a eulogy by Dr. Kristian G. Hansson, which the ARCHIVES OF PHYSICAL MEDICINE has the privilege of reproducing as follows:

DOCTOR JOHN STANLEY COULTER

1885-1949

Life, with its changing cycles, brings experiences of varied kinds — some remembered with pleasure, others laden with sadness. Man has a time for birth and a time for death. However, his days here are not measured by the years spent, but rather by work accomplished. In the course of human events we often pass judgment on our fellow men after they have departed. The estimate of any human being is colored by personal relation and association. I had the privilege of knowing Doctor Coulter for twenty years. He influenced my life as he influenced the life of Physical Medicine during the last two decades and in the light of history he will go down as the Father of Physical Medicine.

Although Doctor Coulter was not in the best of health during his last few years it came as a shock to me as it must have come to all of his colleagues when he passed away on the sixteenth of December, 1949.

All human enterprises have leaders and so has medicine. Physical Medicine was fortunate to have such a leader in Doctor John Stanley Coulter. He proved his leadership in many ways, as a soldier, as an author and editor, as a physician and as a friend to those who sought his advice.

His accomplishments were many: Born in Philadelphia on the twenty-seventh of September, 1885, he received his M.D. degree at the University of Pennsylvania Medical School, 1909, and was graduated from Army Medical School, Washington, D.C., in 1911. At one time he studied Tropical Medicine at the University of Philippines. Leaving the regular army in 1920 he moved to Chicago in 1921, where he became connected with Northwestern University Medical School in 1926 and was made associate professor in 1932 and professor of Physical Medicine in 1943. In Chicago he was in charge of Physical Medicine at Illinois Central, Michael Reese, St. Lukes, Alexian Brothers, Passavant and Wesley Memorial hospitals and was also consultant for the Veterans Administration Hospital at Hines, Illinois.

Dr. Coulter was chairman of the sub-committee of Physical Therapy, National Research Council, charter member of the American Board of Physical Medicine and Rehabilitation and a member of the American Rheumatism Association. He served on the Advisory Committee of the Parmly Foundation for Auditory Research, as Fellow of the American College of Sur-

* Delivered at the Twenty-Ninth Annual Session of the American Congress of Physical Medicine, Denver, September 5, 1951.

geons, and on the Baruch Committee of Physical Medicine and Rehabilitation. All here are familiar with Doctor Coulter's offices in the American Congress of Physical Medicine and the American Society of Physical Medicine.

A member of the board and secretary of the American Registry of Physical Therapists, he also belonged to the Institute of Medicine in Chicago, the American Medical Association, and the Rotary Club.

Doctor Coulter was seldom thought of as a soldier. However, he graduated from the Army Medical School, Washington, D. C., in 1911. He was in the army from 1911-1920. He then studied tropical diseases at the University of Philippines. He served as Lieutenant Colonel, being chief of the personnel department in the Surgeon General's Office, and was sent to France during the first world war, where he took charge of our first overseas convalescent and rehabilitation center. Here Doctor Coulter first became associated with physical therapy and occupational therapy. During the second world war he was Medical Director in the Office of Civilian Defense in the Fifth Corps Area.

Writing and editing occupied much of our colleague's time. He was assistant editor of the ARCHIVES OF PHYSICAL MEDICINE and "Acta Americana." Associate editor of "Principles and Practice of Physical Therapy" in 1934, he also edited "Medical Cyclopedia Service" from 1935-1946. A contributor to "Reiman's Treatments in General Medicine" — 1939, "Barr's Modern Medical Therapy in General Practice" — 1940, and "Glasser's Medical Physics" — 1943, he also was author of the Physical Therapy Sections of the "Handbook of Physical Medicine" and in all contributed fifty-three articles on Physical Medicine and Rehabilitation for medical journals.

As a physician, Doctor Coulter specialized in Physical Medicine and Rehabilitation. Though he maintained wide contacts in general medicine and general surgery, his main achievements were in his own specialty. As soon as he had left the army and moved to Chicago, on the advice of his friends Doctors Magnuson and Mock, he introduced the practice of physical therapy and occupational therapy in the treatment of industrial workers handicapped from disease and accident, a specialty which soon permeated into general medical practice. When this new specialty threatened to become "machine medicine," he helped to establish the Council on Physical Medicine and Rehabilitation and was chairman from 1942-1949. In order further to control and improve the training of physical therapy technicians he helped to form the American Registry of Physical Therapy Technicians.

Doctor Coulter labored continuously for the teaching of Physical Medicine in medical schools and saw in his lifetime most of our medical colleges include some Physical Medicine in their curricula. He lived to see his dearest hopes fulfilled when the American Medical Association formed a Specialty Board of Physical Medicine and Rehabilitation and also a similarly titled Council as a section of the Association.

The enumeration of these accomplishments is an epitome of the history of Physical Medicine in the United States. It is a heritage that Doctor Coulter has left us to cherish and pass on to future generations. The more one thinks of the progress of Physical Medicine during the last three decades, the more one realizes how much we owe to John Coulter and the more convinced one becomes that in him we have the Father of Physical Medicine and Rehabilitation.

After analyzing only part of his accomplishments as a soldier, author,

and as a physician, my personal recollections of John Coulter is that of a friend. To know him was to be his friend. Those of us who had the privilege of knowing him well, who worked with him in his various enterprises during his last twenty years, fully recognize his leadership, appreciate his achievements and rejoice in the honors bestowed upon him.

The American Congress of Physical Medicine presented Doctor Coulter with the Gold Key and expressed its thanks to him in a scroll bearing the following inscription:

IN APPRECIATION OF HIS
UNTIRING AND WELL DIRECTED EFFORTS
TOWARD IMPROVEMENT OF THE
SCIENCE AND THE ART OF PHYSICAL MEDICINE
WHEREBY THOSE WHO
TEACH AND PRACTICE IN THIS FIELD
HAVE BEEN ENABLED IN RECENT YEARS TO
LABOR WITH INCREASING EXPERTNESS
IN BEHALF OF THEIR
STUDENTS AND THEIR PATIENTS.

In further appreciation of the life and work of our colleague and leader we have established a memorial lecture fund, and I am deeply grateful for the honor and privilege of pronouncing this eulogy as the first John Stanley Coulter Memorial Lecture.

PRESENT NEEDS OF THE VETERANS ADMINISTRATION IN PHYSICAL MEDICINE AND REHABILITATION *

A. B. C. KNUDSON, M.D., F.A.P.A., F.A.C.P.*

WASHINGTON, D. C.

The comprehensive medical program of the Veterans Administration includes the specialty of Physical Medicine and Rehabilitation as one of the major services in all hospitals. The need for a well-organized and efficiently operated rehabilitation service is recognized by the Administrator and the Chief Medical Director and their staffs. The most urgent need is in the category of qualified personnel in this specialty.

In order to present these needs more effectively, it is desirable to give a few figures as to the size of this medical program. There are now 150 hospitals in the Veterans Administration. Of this number, 97 are general medical and surgical; 34 are neuropsychiatric, and 19 are tuberculosis. In addition, there are 16 domiciliary homes. Total patients as of February, 1951 were 36,230 general medical and surgical; 54,367 neuropsychiatric, and 15,530 tuberculous. Domiciliary members numbered 17,007, making a grand total of 123,134. The total number of beds authorized as of February 28, 1951 was 118,015. Presently the building program calls for completion of forty-one hospitals to include 27,906 beds, with thirty-three of these hospitals under construction. As of February 28, 1951 there were 20,821 veterans awaiting admission to hospitals. Patients hospitalized by war of service in February were: World War II, 52,415; World War I, 46,552; all other, 7,160; domiciliary members by war of service were: World War II, 1,350; World War I, 14,242; all other, 1,415.

Significance in Rehabilitation

In addition to the hospitals, Physical Medicine and Rehabilitation is established in approximately 60 Regional Offices throughout the country. Here veterans who are service-connected are treated on an out-patient basis in the Physical Medicine and Rehabilitation Unit. The unit usually consists of a Chief, or Acting Chief, Physical Medicine and Rehabilitation, and a physical therapy staff. In a very few of these clinics we have occupational therapy, corrective therapy, manual arts therapy and educational therapy. In the New York Regional Office there is a Blind Rehabilitation Group for the rehabilitation of service-connected blinded veterans. In several Regional Offices there are facilities for Audiology and Speech Correction for the rehabilitation of the hard of hearing. The largest of these is in the New York Regional Office where the audiology staff consists of about 25 professional people.

Aside from the Central Office there are six Area Offices located at Boston, Washington, D. C., Atlanta, St. Paul, St. Louis, and San Francisco. In

* Presented at Eastern Section, American Congress of Physical Medicine, Philadelphia, Pa., April 28, 1951.

* Chief, Physical Medicine and Rehabilitation Div., VA, Dept. of Medicine and Surgery, Washington, D. C.

each of these there is a representative for Physical Medicine and Rehabilitation.

Patient Load. — The increase in patient load in VA hospitals has been progressive and consistent as to trend since World War II. With a veteran population of more than 18,000,000, all of whom are potential patients at one time or another, there is little likelihood of any decrease in hospitalization for a number of years.

Presently, in view of the transfer of Korean casualties, specifically, the long-term and severely disabled cases, which include chronic neurologicals, paraplegics, amputees, the blinded, psychotic and tuberculous patients, the responsibility of Physical Medicine and Rehabilitation is becoming greater. All of these patients will require extensive treatment in Physical Medicine and Rehabilitation, in addition to the other medical services of the hospitals.

Primary responsibilities of the Veterans Administration are concerned with treatment and rehabilitation of the severely disabled, the chronically ill, and long-term patients of all categories. Since the percentage of older veterans in VA hospitals is comparable to the increase in civilian communities, more and more attention is focused on geriatric patients in our hospitals. Secondarily, Physical Medicine and Rehabilitation plays an important part in prevention, diagnosis, treatment and rehabilitation of many other diseases and disabilities, cutting across most of the other medical specialties in order to help in every way possible the other medical services with their patients.

The most important objective is to relieve "frozen beds" and to return the patients occupying those beds to their homes and communities capable of self-care, possessive of self-respect, and able to work at full-time or part-time employment. The measurement of physical capacity and work tolerance thus becomes very important to the physiatrist in effective planning for the patient.

Personnel. — The Physical Medicine and Rehabilitation Service in all hospitals is directed by a Chief or Acting Chief of this Service. Although we have a large number of qualified physiatrists in our hospitals, many of whom are Board Diplomates of this specialty, there are presently vacancies for 56 Chiefs, Physical Medicine and Rehabilitation, and for 5 Assistant Chiefs, many in Deans' Committee hospitals. Small hospitals (150-300 beds) where manager wants Chief Physical Medicine and Rehabilitation—(20-30) more beds. In several of the larger hospitals we have from two to four physiatrists on duty. In all but one of the six paraplegic centers there are at least two physiatrists. During the past six months we have lost seven physiatrists: three to the Armed Forces, two returned to private practice, and two for other reasons (one death, one retirement). During this same period we have been able to recruit only four physiatrists.

The same urgent need exists for residents. There are approved residencies in 12 hospitals with a total of ten residents on duty. Since most of the hospitals are approved for two or more residents, we are anxious to interest young physicians in residency training.

Eighty-three Executive Assistants are on duty in the neuro-psychiatric, tuberculosis and larger General Medicine and Surgery hospitals. Since we are losing several of these men to the Armed Forces, and others are frequently advanced to Assistant Manager positions, we are attempting to re-

cruit highly qualified individuals for vacancies in this category. Many of the Executive Assistants had previous experience in the Armed Forces during World War II and several of them had previous valuable training and experience in civilian rehabilitation in the fields of tuberculosis and psychiatry prior to World War II.

There are approximately 576 qualified physical therapists on duty in hospitals and regional offices. Up to April 18, 1951, 50 physical therapy personnel were called to military duty, as follows: Chief Physical Therapists, 9; Supervising Physical Therapists, 5; Staff Physical Therapists, 12; Physical Therapy Aides, 24. Several of the qualified physical therapists recalled to military duty were lone workers in their respective hospitals, leaving this important therapy unavailable for patients. We have been able to recruit, to our knowledge, seven qualified replacements for the 26 losses. Pending, there are six additional potential losses of physical therapists due to entry into Military Service, of whom two are Chiefs of this Section. In addition, there are 120 reservists among the qualified therapists, and 60 reservists among the aides. Approved clinical practice has been established in 23 hospitals and 4 regional offices, with 21 physical therapy schools. We hope to be able to recruit as many of these students as possible upon completion of their training, but obviously we shall need many more.

A survey made in October, 1950 showed that 97 of 394 Corrective Therapists on duty (approximately 25 per cent) were in the reserves. Since August 1950, 19 corrective therapists have been recalled to duty. In addition, others have been recalled but have been granted delays from 30 days to six months. The breakdown of recalled personnel in this catogory is as follows: Chief Corrective Therapists, 6; Supervising Corrective Therapists, 2; and Staff Corrective Therapists, 11. Five of the therapists were the only corrective therapy personnel on duty in their hospitals. With an increasing load of severely disabled, chronically ill, and Korean casualties, replacement for these personnel is urgently needed in order to hasten rehabilitation and relieve "frozen" beds.

As of February, 1951, we had 1,481 Occupational Therapy personnel on duty, consisting of 989 qualified therapists and 492 aides. In August, 1950 there were 1,054 therapists on duty, thus making a loss as of February of this year of 65 therapists. In August, 1950 there were 455 aides on duty. The total number of occupational therapy personnel recalled to active duty as of April 18, 1951 was 36, broken down as follows: Chief Occupational Therapists, 12; Supervising Therapist, 1; Staff Therapists, 15; Aides, 8. In addition, seven have been altered and are awaiting call or have been granted temporary delays. Clinical practice has been established in 16 hospitals and 20 occupational therapy schools. Recruitment from students has been high (30 per cent).

In August, 1950 there were 346 Manual Arts Therapists and 106 Aides on duty. In February, 1951, the survey showed 329 therapists and 110 aides, a loss of 17 therapists and a gain of 4 aides. Loss to military duty is as follows: Chief Manual Arts Therapists, 2; Staff Therapists, 7; Aides, 1. Five other therapists have been alerted. Records show 47 Manual Arts Therapists to be in the reserves, and 8 aides.

There were 286 Educational Therapists on duty as of August, 1950. In February, 1951, there were 198 on duty, or a loss of 28. Of this number we have lost to the Armed Forces 5 Chief Educational Therapists, and 6 Staff Therapists. There are 50 Educational Therapists in the reserves.

Typical of the need for therapists in the Veterans Administration is the fact that there are approximately 25 vacancies for Chief Occupational Therapists, grades GS-7 and GS-9, and 91 vacancies for Staff Occupational Therapists. In our planning to meet the increasing need for rehabilitation, it is interesting to illustrate the demand in this particular category. Occupational Therapy is very important in the treatment and rehabilitation of tuberculous patients and these patients are increasing steadily. The loss of qualified occupational therapists also adversely affects our "total push" program for psychiatric patients.

Only two of our personnel in Blind Rehabilitation are in the Active Reserves, and none have been recalled to military duty. Thus far we have lost no Audiology personnel to the Armed Forces.

Our records show that of all our Physical Medicine and Rehabilitation personnel, 520 are in the active reserve, and up to April 18, 1951, 111 had reported for military duty.

Aside from actual losses and further potential loss to the armed forces of our personnel, we are losing some personnel to other attractive opportunities in private practice and with other hospitals and clinics. The loss of female therapists of all categories, because of marriage and pregnancy, still continues. Death, retirement, and disciplinary discharge are additional avenues of losses.

Space. — Space requirements of the Physical Medicine and Rehabilitation Service vary considerably in the various types of hospitals and in the regional offices. When a newly constructed hospital is planned in a metropolitan area, the limitation of total footage, as well as present day cost of construction, makes careful planning necessary. In all instances, it is vital to arrange strategic scheduling of patients for treatment in the various Physical Medicine and Rehabilitation clinics, so as to make the most efficient and effective utilization of space. In many of the hospitals which were transferred from the Army and Navy to the Veterans Administration, following World War II, the problem of scarcity of space did not exist. In fact, in many instances too much space was given to the Physical Medicine and Rehabilitation Service, and subsequently it could not be or was not utilized to the best advantage.

Space requirements are modified according to need in accordance with new techniques and activities, where space is a consideration for the administration of these to the patients.

Equipment. — Equipment lists are being constantly revised in view of changing needs and trends in the field of Physical Medicine and Rehabilitation. Older equipment which is still needed for treatment purposes is repaired to keep it in good working condition. However, when further repair is no longer feasible, it is replaced by new equipment of the best type available. Apparatus which becomes obsolete is surplussed and replaced by new apparatus.

Considerable equipment was obtained by transfer from the armed forces following World War II. Much of this has since worn out and has been replaced. In other instances, some equipment was obtained which was too large, heavy and cumbersome to be of practical use in the various clinics. Most of this equipment has now been replaced by more suitable equipment for treatment needs.

Supplies. — As in the case of equipment, supplies are a constant need but usually on an expendable basis in the Physical Medicine and Rehabilitation clinics. Supply lists are kept up-to-date so that the field may know what is available and where obtainable.

Physical Medicine and Rehabilitation Beds. — Since June of 1949 a total of 1,148 beds in various Veterans Administration hospitals has been allocated to the Physical Medicine and Rehabilitation Service. Of this number there are 634 beds in 26 General Medicine and Surgery hospitals, and 514 beds in 9 tuberculosis hospitals. These beds are the direct responsibility of the Chief, Physical Medicine and Rehabilitation Service, and are of considerable help in providing more effective and intensive rehabilitation for patients. They also provide a means for better training of residents and other personnel, as well as residents from other medical services who rotate through the Physical Medicine and Rehabilitation Service.

The effectiveness of a well-operated Physical Medicine and Rehabilitation bed service is attested by reports received from several hospital managers. Perhaps two of the most outstanding are those from the Veterans Administration hospital, Fort Howard, Maryland, and the Veterans Administration hospital, Bronx, New York. At the former hospital there are 15 of these beds. During the first year of operation, 60 patients were admitted to this service and following completion of rehabilitation were discharged. Not a single one of these patients has been readmitted. The Dean's Committee of the Johns-Hopkins Medical School wrote letters of commendation to the manager of the hospital and to the Chief Medical Director, stating their praise for the effectiveness of this type of service. At the Bronx Hospital there are 52 Physical Medicine and Rehabilitation beds. This service has also established a unique record in the intensive rehabilitation and discharge of patients. A detailed analysis was made of the classes of patients, the types of treatment given, the amount of vocational advisement, and other data which confirmed the desirability of a bed service in Physical Medicine and Rehabilitation.

The establishment of a Physical Medicine and Rehabilitation bed service strengthens this specialty in the hospital. Treatment is still given patients from all other services through consultation with the Chief in Physical Medicine and Rehabilitation, either on the wards or in the various Physical Medicine and Rehabilitation clinics. More managers of Veterans Administration hospitals are establishing this type of bed service as a part of their bed allocation. Other managers are planning to establish such a bed service in some of the larger hospitals as soon as they are able to obtain another physiatrist to assist the Chief in Physical Medicine and Rehabilitation

We sincerely believe that there is a need for more bed services in the Veterans Administration to relieve frozen beds, thus providing more intensive rehabilitation, better training facilities, and new opportunity for research and clinical studies.

Training. — There is a constant need for training courses for Physical Medicine and Rehabilitation personnel in our installations. In spite of considerable training initiated in 1943 at the Mayo Clinic, Northwestern University Medical School, and Columbia — followed later by three 12-week schools at the Veterans Administration Hospital, Hines, Illinois, and more recently by the detail, in accordance with availability of funds, of groups of Veterans Administration physiatrists to New York University-Bellevue Medical Center — there are frequent requests from our managers to provide training for Acting Chiefs, Assistant Chiefs, and other part-time physicians associated with the Physical Medicine and Rehabilitation Services of hospitals and units of regional offices. It is encouraging to note the steady and healthy growth of this service in the opinion of managers, as one of the most important of their medical services to patients.

Training, of the refresher and post-graduate types, is necessary for our therapists to keep them informed of new procedures and developments. Because of the complexities of medical rehabilitation and the ramifications of this specialty into vocational advisement, industry, community affairs, social status and the nation's economy it is important that we keep alert to opportunities for training.

Research. — Although our entire purpose and function in the Veterans Administration is the treatment and rehabilitation of the veteran patient, we are deeply interested in research as it affects that medical treatment with a view toward constantly improving it. We need the stimulus, the results, the evaluation which scientific research can give us and our specialty for improved patient care.

There is a concomitant need for implementation and support of the writing of scientific papers and development of scientific exhibits. There has been a constant increase of these by our personnel in the field and it is believed that this is healthy; it is an indication of the interest and quality of people engaged in this work in the Veterans Administration. The following summary is given: Papers, overall Veterans Administration: 1920-1; 1925-0; 1930-18; 1935-22; 1940-40; 1945-53; 1948-535; 1950-713, incomplete; 1951 to date, 217. Physical Medicine Rehabilitation exhibits since 1945 have been well over a hundred.

Miscellaneous. — There can always be improvement of our own status within our own framework and with the other medical services. There is a need for better coordination of our own activities so as to make them more effective for the patient, and a need for continued integration of our contribution with the total team job being done for him.

There must be further implementation, improvement and refinement of our Medical Rehabilitation Boards in hospitals. They are an effective means of guiding the severely disabled patient toward a well-planned objective that will make him independent again.

We see the urgent need for adequate and well-directed vocational advisement and guidance, so that the complete job may be done. All of our work with the patient may be dissipated if this part of the chain is weak or missing.

Perhaps the final and tell-tale need in our present program is that of follow-up, so that we may know how effective our work is for the patient,

so that we can be aware of what happens to him when he leaves the hospital, and thus that we may take proper steps if we see that the total plan for his successful rehabilitation is faltering when he is out and on his own.

Summary

The scope and complexity of the Physical Medicine and Rehabilitation Service in the Veterans Administration has been presented. The numerous problems we have at this time have been briefly described. We know that as some of them are solved others will develop. We wish to emphasize the excellent and unsurpassed opportunity for service to veterans and for professional development in Physical Medicine and Rehabilitation in the Veterans Administration; opportunity for clinical work, teaching, research and effective administration.

Constructive criticism is welcomed so that we may further improve this specialty in the Veterans Administration. Help is sincerely solicited whether it comes from within or without the Veterans Administration in enabling us to meet these needs, and especially in the procurement of qualified personnel to do the job.

OBJECTIVE RECORDING OF THE STRENGTH OF NORMAL MUSCLES *

EARL C. ELKINS, M.D.

Section on Physical Medicine and Rehabilitation, Mayo Clinic

URSULA M. LEDEN, M.D.

Fellow in Physical Medicine and Rehabilitation, Mayo Foundation

and

KHALIL G. WAKIM, M.D., Ph.D.

Section of Physiology, Mayo Clinic

ROCHESTER, MINNESOTA

As has been pointed out previously,[1] there is a need for standard, objective tests for evaluation of muscular strength. This presentation is a report of progress in that direction. However, there are many factors involved in the measurement of either normal or abnormal muscular strength. It is difficult to devise an exact, objective method for the measurement of strength which will be satisfactory to all testers. Certainly, great numbers of studies would have to be done on many subjects to establish what strength is necessary in certain muscles to produce normal function of a given part. Certain factors may be studied and standardized, in relation to position of the part, to determine which may give the best possible leverage and the best muscular tension, including consideration of gravity and functional positions.

Investigation of some of these factors was the purpose of our previous[1-2] and the present studies on measurement of muscular strength made of normal muscles. It is hoped that optimal positions for the function of normal muscle can be established and applied to the testing of muscular strength in neuromuscular diseases.

Apparatus and Method

The equipment used in this investigation was the same as that used previously.[1]

A strain gauge was used to measure the strength of the muscular contraction. An aluminum alloy ring contained the four elements of the strain gauge, two attached to the outside and two to the inner side. One end of the ring was hung on a hook firmly attached to the wall; the other end was connected to a steel chain attached to the sling into which the extremity to be tested was inserted. A turnbuckle was included in the chain to permit fine adjustment. Changes of resistance in the strain gauge produced deflections in the galvanometer, which were read on a calibrated scale. The elbow flexors, extensors, shoulder abductors, and hip flexors of normal young men and women were studied.

As previously shown by Hellebrandt and associates,[3] it was found that a rest period of about sixty seconds between contractions was necessary to

* Read at the Twenty-Eighth Annual Session of the American Congress of Physical Medicine, Boston, Aug. 29, 1950.

1. Wakim, K. G.; Gersten, J. W.; Elkins, E. C., and Martin, G. M.: Objective Recording of Muscle Strength, Arch. Phys. Med. 31:90 (Feb.) 1950.
2. Clarke, H. H.; Elkins, E. C.; Martin, G. M., and Wakim, K. G.: Relationship Between Body Position and the Application of Muscle Power to Movements of the Joints, Arch. Phys. Med. 31:81 (Feb.) 1950.
3. Hellebrandt, F. A.; Parrish, Annie M., and Houtz, Sara J.: Cross Education; the Influence of Unilateral Exercise on the Contralateral Limb, Arch. Phys. Med. 28:76, 1947.

avoid the fatigue which interferes with the lifting of the load. Most untrained subjects required a few contractions as a warm-up period. All experimental data represent an average of two or more observations made under identical conditions.

Elbow Flexion

Tests of the power of elbow flexors were done with the subject in a supine position on a plinth. The skin of the arm, forearm and elbow was marked, in order that the angle of the elbow could be more nearly accurately and repeatedly measured. During each test, the angle was measured at the peak of contraction. To prevent slipping of the subject on the plinth during the test, a footboard was attached to the table. Muscular strength was studied both with and without the use of the footboard. This was done to substantiate further our previous work.[2] Flexion of the right forearm was studied with the arm adducted to the side in neutral position. In some of the observations, the sling was fixed first on the forearm at a point midway between the elbow and the wrist, by actual measurement, and then at the wrist. With the sling at the wrist, muscular strength was compared with the forearm in midposition, the position used in one investigation,[2] and in pronation and supination, the positions used in another.[1]

The angle at the elbow was varied, and observations were made at 60, 80, 90, 100 and 120 degrees. To maintain perpendicular relationship between the forearm and chain, the ring was shifted to hooks at different levels as the angle of the elbow was changed. When the subject's elbow was resting unsupported on the plinth, there was an angle of 15 to 20 degrees extension at the shoulder joint. It was suggested that this position might increase the tension of the biceps, and therefore improve its power. Several observations were made with the elbow elevated to a position of 0 degrees at the shoulder to eliminate this factor.

Results

The Effect of the Footboard on Muscular Power (table 1). — Comparison of muscular power was made with and without the use of the footboard. When no footboard was used, the flexed knees of the subject were braced at the ankles, similar to the procedure used previously.[2] In fifteen observations on four women, the average pull in the presence of the footboard was fifty-seven pounds, and without the footboard, 53 pounds, an average difference of 4 pounds. In twelve observations on three men, the average pull of the forearm flexors in the presence of the footboard was 102 pounds, whereas without the footboard it was 88 pounds, the average difference being 14

TABLE 1. — *Comparison of Force of Elbow Flexors With and Without Use of a Foot Support*

Sex	Mean Pounds Force With Foot Support	Mean Pounds Force Without Foot Support	Difference
Female	57±2.3*	53±2.0	—4†±0.7
Male	102±4.0	88±3.6	—14†±2.8

* The figure after the ± is the standard error of the mean.
† Calculated from paired differences.

pounds. The smaller difference recorded among female subjects was believed to be due to more effective bracing than was possible in subjects who could pull greater poundage. To eliminate this source of error, in all further observations on elbow flexion, the footboard was used.

Comparison of Position of Sling on the Forearm (figure 1). — The strength of elbow flexors was studied with the elbow at various angles; first with the sling fixed on the forearm, midway between the elbow and wrist, by actual measurement; and then at the wrist joint. Twenty experiments on thirteen women and eleven experiments on nine men are summarized graphically in figure 1. There was a definite relationship between the force measured at

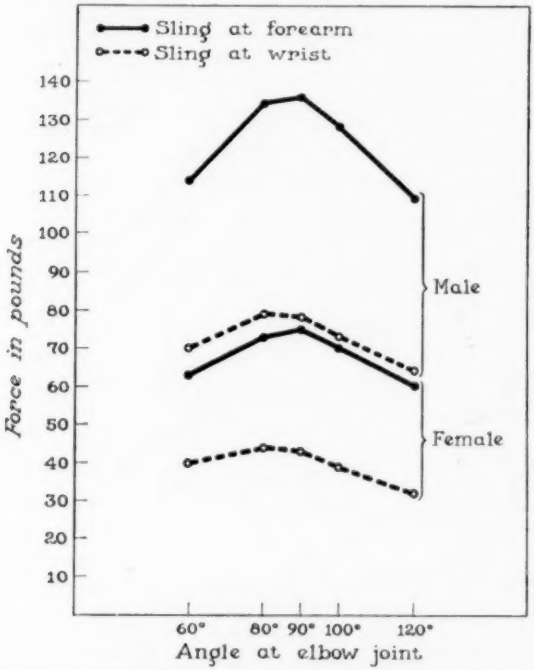

Fig. 1. — Comparative effects of placing the sling at the forearm and at the wrist on the strength of elbow flexors with the elbow joint at various angles.

the wrist and that measured at the forearm. This was consistent throughout the experiments. The position of the sling at the wrist was found to be much easier to maintain, since the sling slipped on the forearm, especially in the short, stocky subjects. Also, placing the strap at the wrist was found to be more comfortable for the subjects than when it was at the midforearm. It was noted that there was 23 to 32 pounds difference in the amount of pull in the women and 44 to 55 pounds in the men when the sling was applied at the midforearm as compared with the amount of pull when the sling was placed at the wrist.

Comparison of Forearm Positions (figure 2). — The power of the elbow flexors was studied with the strap at the wrist, with the elbow at varying angles, and with the forearm in midposition, in supination and pronation. The average difference in power between the three positions used in 10 experiments on 9 normal women was not greater than 2 pounds (fig. 2). Maximal individual differences in power were 6 pounds. Ten experiments

on 9 men are also summarized in figure 2. The average difference in power between the three positions was not greater than 7 pounds. The maximal individual difference was noted in one subject, in whom the difference was up to 18 pounds, with the greatest force of contraction in midposition at all angles. Evidently the midposition is slightly more efficient than supination or pronation. This is probably due to the fact that the muscles of the forearm which aid flexion of the elbow act most effectively in midposition.

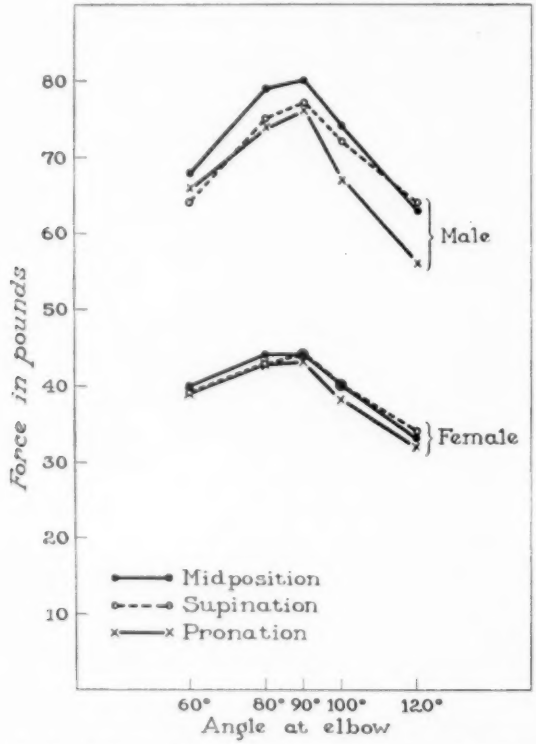

Fig. 2. — Influence of the position of the forearm on the strength of elbow flexors at various angles of the elbow joint.

Influence of Angle at the Elbow on Muscular Power. — The data from the previous group of experiments indicate that for both positions of the straps on the forearm, muscle power was greatest during elbow flexion at 80 to 90 degrees. The curve in figure 3 agrees with those obtained previously,[2] but the results differ in that the peak of strength obtained was near 120 degrees in one study,[3] rather than 80 or 90 degrees, obtained in later studies[1] and in the present one. It is believed that the reason for this discrepancy lies in the method of measuring the angle at the elbow.

Effect of Elevating the Elbow. — Fifteen observations were made on 6 female subjects, first with the elbow resting on the table at about 15 to 20 degrees extension of the shoulder, and then with the elbow elevated to ob-

tain 0 degrees extension of the shoulder. The average pull was the same with and without the elbow support (fig. 3); the pull with the elbow supported was slightly greater in 7 observations, slightly less in 6, and the same in 2. The maximal difference was 3 pounds.

Seven observations were made on 4 female subjects without elbow support, and then with the elbow raised to 90 degrees flexion at the shoulder. This was accomplished either by having the subject lie supine on the plinth with the ring fastened overhead, or by having the subject sit with the elbow resting on a high support. The pull with elbow support was slightly less in five observations, slightly more in one, and the same in one. The maximal difference was 7 pounds. The greater difference in these positions is attributable to the difficulty in stabilizing the subject adequately, and is not necessarily significant.

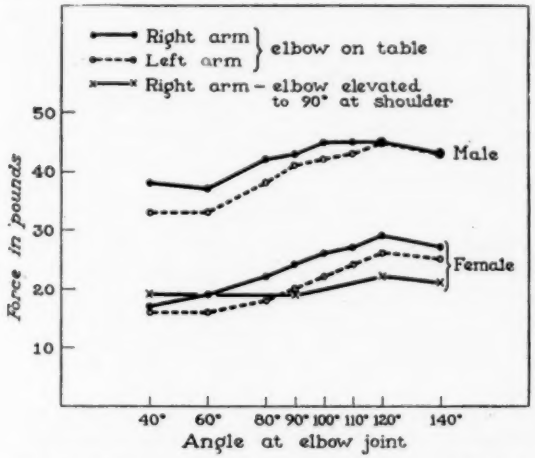

Fig. 3. — Strength of elbow extensors in both arms at various angles of the elbow joint.

Comment

Since a definite relationship exists between the force of contraction measured by the sling at the wrist and that measured at the forearm midway between the elbow and wrist, it seemed justifiable to use the position at the wrist as the test position. It was considered that not only was this position much more comfortable for the subject and easier to maintain, but it was a more functional approach to the study of normal flexion, since weight usually is lifted with the hand, and not with the forearm. It was found that, on the average, there was little difference between the force exerted in supination, pronation or midposition (fig. 2). In a few individuals there appeared to be an unusual decrease in power upon changing from midposition to supination. On the whole, the midposition appeared to be most favorable for normal subjects, and was therefore used in all the other experiments.

The angle at the elbow was found to be of considerable importance. In all individuals tested, the force exerted was greatest at 80 to 90 degrees flexion of the elbow. This is in agreement with earlier findings.

Elbow Extension

Procedure. — The subject was placed in a recumbent position with the elbow resting on the table. The angle at the elbow was measured in the same manner as that used for the elbow flexors. The sling was attached to the wrist in the same position as that in the previous study.[1] The rings were attached to the hooks on the wall behind the head at the end of the table. Both arms of all subjects were studied. Since this position was antigravitational in relation to some angles, and gravity-assisted in relation to others, a complete antigravity position also was tested. This was obtained by elevating the elbow to an angle of 90 degrees flexion at the shoulder joint. The ring was attached to hooks at the bottom of the table for some angles (60 and 90 degrees), and to the wall for the others. The elbow had to be stabilized by the operator in this position, which could not be used accurately on powerful men. The position was used for the right arms of the same group of women who had been tested in the other position. The results are summarized graphically in figure 3. Observations of fourteen women and ten men showed a gradual increase in power as the elbow was extended, with the peak at 120 degrees. In both male and female subjects, the left arm showed a similar strength curve at the right, but slightly lower at most angles. As expected, the complete antigravity position gave slightly lower readings at the greater angles, as compared to readings made in the positions in which gravity assisted.

Comment

It was difficult to stabilize strong persons for this particular test and to prevent elevation of the shoulder and elbow. The peak of power obtained in earlier studies[2] at the 40-degree angle must be due to insufficient stabilization, allowing protraction of the shoulder. A similar peak could be obtained in our subjects under those conditions. The power of the triceps could not be measured at 180 degrees, because exertion of rotary force is not possible in full extension.

Except for the peak at 40 degrees and the slight peak at 60 degrees obtained by Clarke,[4] our curve agrees with the peak at 120 degrees.

Shoulder Abduction

Procedure. — With the subject sitting upright at the end of the table, feet resting on a chair and back supported by a vertical back rest, the sling was attached to the arm immediately above the elbow. The ring was attached to hooks at the bottom of the table (for 110, 90, 80 and 60 degrees), or at the wall to the left of the subject, with the chain passing behind the subject's back (for 40 and 10 degrees). The arm was held with the palm down, and in internal rotation to eliminate as much action of the biceps as possible. The elbow was held in both the flexed and the extended position for each angle of the shoulder studied. Since the forearm had to be lifted against gravity, and held there while adjustments were made, this test usually was done in two stages, to avoid fatigue.

Results. — The findings were relatively consistent, but not so consistent as in any other muscle tests. Observations of thirteen women and ten men showed that the force obtained was slightly less with the elbow extended than with the elbow flexed (fig. 4). In the male subjects there was a stronger pull at a very small angle, 10 to 40 degrees, and

4. Clarke, H. H.: Further Development of Objective Strength Tests of Affected Muscle Groups Involved in Orthopedic Disabilities. Office of Naval Research Contract N8onr65706, Technical Report, October 1, 1949.

at the larger angle of 110 degrees, with a slightly weaker pull in between (60 and 80 degrees). This was not apparent in women, whose strength was almost uniform throughout the entire range tested, with only a slight rise at the greater angles (fig. 4).

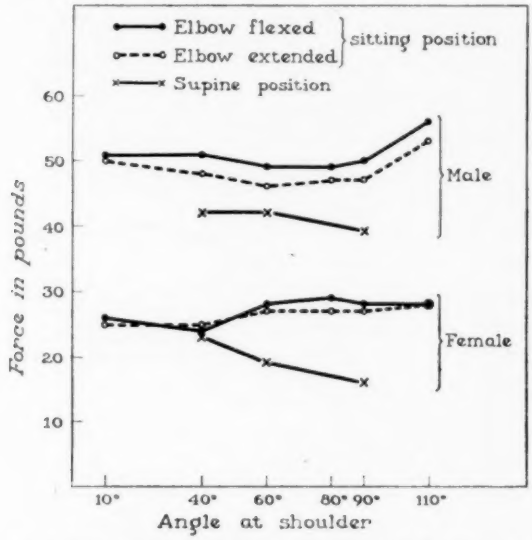

Fig. 4. — Strength of shoulder abductors with the subject in the sitting or supine position, with the elbow flexed or extended.

It was very difficult to stabilize the subjects in this particular test. There was a tendency for the shoulder to be elevated and for the trunk to tilt. It is believed that the peak of power of the same test, obtained previously[2] at 0 = degree abduction (quoted as 180 degrees), was due to insufficient stabilization and tilting of the trunk, because in the present study the trunk could not be stabilized in this position. Ten degrees of abduction was the smallest angle used, because it was impossible otherwise to detect or prevent tilting of the trunk.

Ten female and seven male subjects were studied in the supine position, similar to that used by Clarke.[4] The findings were not comparable to those obtained in the sitting position, as will be noted by the results indicated in figure 4. There was considerably greater power exerted with the subject in the sitting position than there was in the supine position in both groups of experiments.

It was observed that the abductor power of the shoulder was greatest above 90 degrees, but this is not the action of the deltoid, except for stabilizing power. However, it indicates that the deltoid alone is as powerful as, or more powerful than, the combined action of the muscles which produce rotary action of the scapula.

Hip Flexion

Procedure. — With the subject sitting at the end of the table with feet resting on a chair, the sling was attached to the thigh just above the knee.

The ring was attached to a hook on the bottom of the table. The subject's back was supported by a back rest which was adjustable, so that the angle at the hip joint could be varied simply by changing the angle of the back rest. The subjects used their arms to hold onto the sides of the table to prevent their pelves from tilting or rising on the side being tested.

Results. — Observations on fourteen women and ten men indicated that the hip flexors increase in strength as they are put on stretch (fig. 5). As shown previously,[2] the power of hip flexors forms approximately a straight line upward to 90 degrees, and continues to increase from there almost to full extension, the peak of strength being at 150 degrees, with only a slight decrease at 170 degrees. These data were very consistent and repeatable.[3]

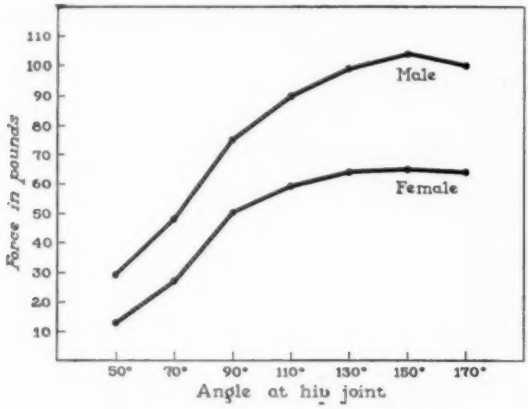

Fig. 5. — Strength of hip flexors with various angles at the hip joint.

Previously, measurements were not made beyond 90 degrees, although the curve still showed a sharp increase. The position used by Beasley[5] appeared almost impossible, since in acute flexion at the hip joint, there was little power in the normal hip flexors.

Comment

The instrument used for measurement of power in these studies was comparatively simple, and the tests could easily be duplicated. The method is completely objective, since the power measured is that of the strength of the subject only, and does not depend on the application of any outside force. The amount of power that can be measured is not limited by the instrument, as in the case of the use of the Newman myometer, nor by the strength of the operator, which may be the case when the Beasley myodynamometer is used.

Any use of instrumentation to determine muscular strength will require considerable time for the test and will make it cumbersome.

These studies corroborate the curve of strength found previously[2] in the elbow flexors, and the angle at which the elbow flexors function with greatest strength.[1] From the standpoint of function, it may be assumed that the elbow flexors exert the greatest power when the elbow is at a right angle,

5. Beasley, W. C.: Manual on Clinical Techniques for Quantitative Muscle Testing With the Myodynemeter. U. S. Public Health Service, 1949.

since this is the most frequent position used in producing maximal strength in everyday activity. Whereas there was a slight difference in strength when the forearm was in the supinated position, pronated or midposition, it was not of great significance.

The findings in the measurement of the elbow extensors were somewhat as expected; namely, (1) that the triceps are considerably weaker than the flexors of the elbow; (2) that they are in a position to produce their maximal power when they are under minimal, or near minimal, length and tension. Why the shoulder abductors were more efficient in the sitting position was not clear. It may be argued that there was not sufficient stabilization of the trunk. However, it was impossible to stabilize completely the action of the muscles of the trunk with the subject in either the supine or the sitting position.

The power of the hip flexors should be greatest at the angle at which they are near their greatest length, where they still have a few degrees of flexion in order to have a strong rotary component. In acute flexion of the hip, all the groups of muscle acting in flexion would be at a marked disadvantage because of the loss of length and tension. The findings obtained from these various muscle groups indicated that muscles functioning at optimal power are not always at greatest length and tension; rather, they function best in the optimal physiologic position.

ELECTROMYOGRAPHY OF FATIGUE *

G. CLINTON KNOWLTON, Ph.D.
Department of Physical Medicine, Emory University School of Medicine

ROBERT L. BENNETT, M.D.
Department of Physical Medicine, Georgia Warm Springs Foundation

and

RICHARD McCLURE
Technical Assistant

Observations by Cobb and Forbes[1] established that in rapid fatigue there is an increase in the amplitude of the summated action potentials of the exercising muscle. The relation of load and work rate to the fatigue electromyogram was not defined in that study and it is the purpose of this paper to present the results of observations made on control muscles doing work to subjective fatigue with various loads and at several work rates. These

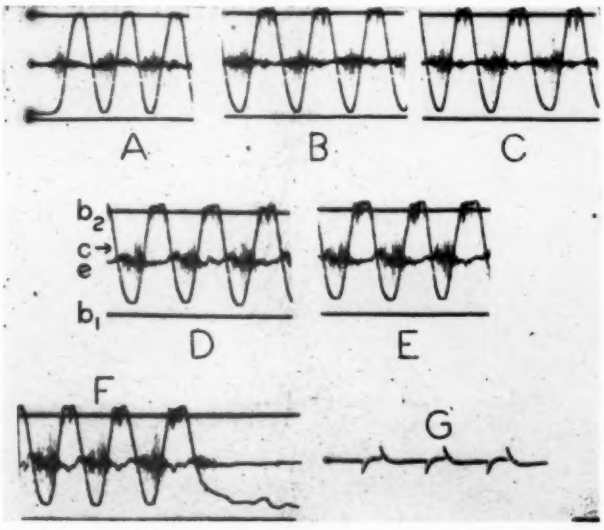

Figure 1. — Control Electromyogram. Load 15 pounds. Rate 58 lifts per minute. Total number of lifts 64. b_1 is the base line for the 165° position of the arm, b_2 is the base line for the 95° position of the arm. c traces the arm position during the exercise. e is the action potential record. A represents contractions 1, 2, 3. B 11, 12, 13; C 24, 25, 26; D 36, 37, 38; E 49, 50, 51; F 62, 63, 64. G voltage calibration one millivolt plus and minus.

results show that the electromyograph pattern of fatigue is definitely altered by changes in the work load and rate. On the basis of these results a test regime is described and some data obtained in a limited application of the test to poliomyelitis muscles are presented.

* Read at the Twenty-Eighth Annual Session of the American Congress of Physical Medicine, Boston, Aug. 30, 1950.

1. Cobb, Stanley, and Forbes, Alexander, American Journal of Physiology 65:234, 1923.

The test muscle used was the biceps brachialis. The exercise consisted of lifting a hand held weight at a given rate to the point of subjective fatigue. The range of movement was from 165 degrees to 95 degrees with reference to the angle of the upper arm and forearm at the elbow. The hand and forearm were held in supination throughout the movement. Action potentials were detected as the voltage difference between two solder electrodes, each six mm. in diameter, placed on the skin, one over the motor point of the short head of the biceps, the other at the tendon end of that muscle. The potentials depicted on a cathode ray oscilloscope were recorded on slowly moving film. Arrangement was made to record the range of motion for each contraction on the same film. The record was analyzed for the number of contractions to fatigue and then the action potential voltage was measured for the first three contractions and three contractions each about the points of 20, 40, 60, 80 and 100 per cent of the lifts to fatigue. Such a record is shown in figure 1.

Results relating to the load and the electromyogram voltage during work to fatigue are shown in table 1. In these observations the work rate was

TABLE 1. — *Relation of the Fatigue Electromyogram to Load.*

Load lbs.	Number of Lifts	Initial Voltage Millivolts	Action Potential in Per Cent of Initial Voltage at Fatigue Level of 20%	40%	60%	80%	100%
5	1003	1.24	110.	125.	138.	141.	160.
10	254	2.42	127.	129.	134	152.	169.
15	91	3.31	129.	152.	167.	183.	199.
25	28	5.00	109.	120.	126.	125.	121.

kept constant at 58 lifts per minute and the same six subjects were observed for each of the four loads. At least two days intervened between exercise bouts. In terms of absolute voltage the initial potentials increased with increased load. During repetitive lifts there was an early increase in the action potential amplitude, which became greater as the fatigue point was reached. The rate and extent of this voltage increase was related to the load carried, being moderate for light loads, increasing through a maximum as the load was increased, and then decreasing with very heavy loads.

Data concerning the relation of work rate and the fatigue electromyogram are given in table 2. Four of the six subjects used for the results of table 1 were used here. A constant load, fifteen pounds, was carried by each subject at each of the three exercise rates. The initial voltages were fairly constant, as they should be for constant loads. The results indicate a slow increase and low final level of action potential voltage for slow work

TABLE 2. — *The Relation of the Fatigue Electromyogram to Work Rate.*

Lifts Per Minute	Number of Lifts	Initial Voltage Millivolts	Action Potential in Per Cent of Initial Voltage at Fatigue Level of 20%	40%	60%	80%	100%
29	288	2.77	111.	107.	118.	108.	120.
58	91	3.31	129.	152.	167.	183.	199.
116	59	3.34	128.	135.	131.	145.	155.

rates: an increase in the rate and extent of the voltage response through a maximum as the work rate is increased, and then a decrease as the work rate is further increased.

It is to be noted that the alterations in the fatigue electromyogram pat-

tern resulting from changes in load or rate are quantitative. The general result, that the action potential amplitude is greater at fatigue than at the initial contractions, is obtained in control individuals with all loads that can be lifted repetitively at rates that can be performed.

From these results it is obvious that in order to use the action potential amplitude during repetitive muscle contractions as an assay of the muscle, there must be a standardization of the work load and rate. This has been attempted by defining the load as one-half the maximum load that the muscle can lift and the rate as 58 lifts per minute. Using the electrode placement described above, the results shown in table 3 were obtained. The con-

TABLE 3. — *Relation of the Fatigue Electromyogram to Muscle Grade.*

Muscle Grade	Load = ½ Maximum. Load lbs.	Number of Lifts	Initial Voltage Millivolts	Rate = 58 Lifts Per Minute. Action Potential in Per Cent of Initial Voltage at Fatigue Level of— 20%	40%	60%	80%	100%
Control	14.	54	1.51	120.	141.	153.	166.	181.
G+	3.8	71	1.92	117.	133.	143.	148.	161
G	1.5	76	3.09	102.	105.	107.	104.	105.
G—	1.7	60	2.50	106.	108.	112.	110.	111.
F+	1.1	34	2.95	102.	99.	97.	92.	91.

trol electromyogram shows quantitative differences from those for the poliomyelitis muscles. These differences vary from grade to grade, giving in general the result that the poorer the manual muscle test grade is the less increase there is in the electromyogram voltage at fatigue. Actually the variations in the individual tests for the muscles of grades G— and F+ were rather great so that the G— group was divided into three sub-groups and the F+ group into two sub-groups. These are summarized in figure 2, which illustrates that the departure from the control voltage curve, is least marked for the G+ muscles, becomes more obvious for G—1, is about the same for the G, G—2, and F+1, making these appear as very similar muscles, and finally shows actual reversal in the muscles classed as G—3 and F+2.

The genesis of the voltage increase of the electromyogram as fatigue is approached can be explained by the observations of Kugelberg and Skoglund[3] on individual motor unit response of human muscle. They noted that the lowest threshold motor nerves evoked responses of motor units giving low action potential voltages and that the higher threshold units gave higher action potentials. In observing the summated action potentials from many motor units, as is done when recording from skin electrodes spanning the muscle, it appears that an increased potential can occur in two ways: by better synchronization of a given number of units and by recruitment of motor units. The fact that recruited motor units give a higher voltage per unit than do the initial units would allow for a higher voltage at fatigue even if the initial units dropped out of action. Thus the variations in the fatigue potential increment at different loads can be rationalized on the basis of the differences in the motor unit reserve at the initial lift. The variations in the fatigue electromyogram with changes in work rate are not predictable on this basis. Why variations in lifting rate should alter the motor units eventually susceptible to command (except as a higher rate simulates a greater load in requiring a higher power rate) is not clear but does suggest that the point of subjective fatigue depends on different factor combinations at different work rates.

Reference to tables 1 and 2 and figure 2 shows that the voltage patterns

3. Kugelberg, E., and Skoglund, C.R., Journal of Neurophysiology 9:399, 1946.

shown by muscles rating G+, G—1, G—2, G and F+1 could all be duplicated by control muscles working at appropriate loads and rates. To be sure, an attempt has been made to grade the load to the muscle capacity by using a load equal to one-half the maximum strength. No such equalization has been made with regard to rate. Nevertheless the curves shown in figure 2 approximate what would be predicted from the manual muscle test and the genesis of voltage increase on repetitive effort outlined before. Thus for such muscles the information yielded by the electromyograph fatigue test is more sophisticated but not much more informative clinically than the manual muscle test.

While the number of poliomyelitis muscles tested is very small, it seems clear that those grouped as G—3 and F+2 give fatigue electromyograms quite different from the control and better grades of muscle. This difference is noted in the behavior of the action potential amplitude during repetitive activity and is distinguished by a decreasing rather than an increasing voltage as the muscle works to fatigue (figure 2). This result can be obtained

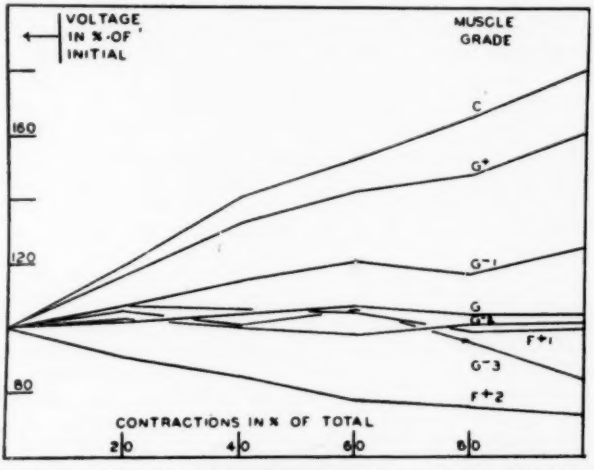

Figure 2. — Relation of the Fatigue Electromyogram to Muscle Grade. Taken from table III except that G— is divided into G-1, G-2, G-3 and F+ is divided into F+1 and F+2; these subdivisions being on the basis of the voltage at the fatigue point.

in control muscles by loading the muscle beyond its capacity to lift the load. Then, on repeated attempts to lift the load the action potential decreases. But these poliomyelitis muscles were not loaded beyond their capacity to lift the load. Such a response when carrying approximately one-half the maximal load may have some significance. That is, a muscle responding in this way is very likely to deteriorate if placed on an unrestricted exercise program. It is a matter of clinical experience[3] that when individuals with poliomyelitis-affected muscles are placed on a functional program after proper preparation, in most individuals continued improvement is shown. But in some individuals, under the same regime, certain muscles may become weaker. There seems no certain way to detect such muscles before the fact. There is no certainty that the electromyograph fatigue test will enable one to do

3. Lundervold, H., and Scyfforth, H., Acta Psychiatrica et Neurologie 17:69, 1942.

so. The several instances, however, in which we have observed the reversed fatigue voltage followed by muscle deterioration during subsequent functional activity, suggest that the accumulation of such experience might lead to a clinically useful method for detection of such muscles.

Summary

The amplitude of the electromyogram shows a progressive increase from the initial to the final contractions of control muscles carrying moderate loads to subjective fatigue.

The rate and extent, but not the direction, of this voltage change is altered by changes in load and work rate, there being an intermediate load and rate where the voltage increase becomes maximal.

Using a load graded to the muscle strength and a rate of 58 lifts per minute, poliomyelitis muscles of grades G+ to F+ showed smaller voltage increases at fatigue than did control muscles. In general, the better the muscle grade the closer the response was to that of the control muscles.

Certain muscles of grades G— and F+ gave a reversed voltage response in that the action potential voltage decreased during repetitive contractions. In a few individuals this type of response was associated with muscles which later decreased in strength during a functional exercise program.

EFFECT OF ANODAL AND CATHODAL CURRENT AND NOVOCAIN ION TRANSFER ON TENSION PRODUCED IN MUSCLE BY DIRECT ELECTRICAL STIMULATION *

JEROME W. GERSTEN, M.D., M.S.**

DENVER, COLORADO

In the experimental animal, the beneficial effects of electrical stimulation of denervated muscles have been carefully described.[1-a-b-c-d] Such effects include increase in diameter of the muscle fiber, increase in muscle weight and power, decrease in the amount of fibrosis, decrease in water content, increase in oxygen consumption, and lesser fatigability.[1] The sine wave, with a frequency of approximately 25 cycles per second, has been found the most effective in producing these favorable structural and functional changes.[2-a-b-c] One of the most important factors in attaining the desired therapeutic end seems to be the development of sufficient tension during contraction. It has been suggested that the above observations may not apply to man, since the current intensities required to produce vigorous contractions could never be employed in a patient.[1c]

The primary purpose of this study was to determine in man the amount of tension which could be produced in a muscle by stimulating it electrically, and the effect of constant current and procaine (Novocain) hydrochloride ion transfer on the tension resulting from such electrical stimulation.

Methods

Most of the studies (thirty-nine observations) were made on normal subjects. Eight patients with nerve section or anterior poliomyelitis were studied, and brief reference will be made to these observations. In all subjects it was the elbow flexors which were stimulated electrically. The stimulating electrodes were circular and of the same diameter (2 cm.), and were placed on the elbow flexors so that a line joining them was parallel to the longitudinal axis of the arm. A standard variable sine wave stimulator*** was used, and the range of frequencies studied was from 2 to 360 cycles per second.

In all the observations, the subject was seated, with the arm abducted 90 degrees and the forearm flexed to 90 degrees and pronated. The elbow was fixed by an appropriate number of weights so that the only motion which

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** Assistant Professor of Physical Medicine and Rehabilitation, University of Colorado School of Medicine.

The author acknowledges with gratitude the aid given by Mr. Herbert Levy in the performance of these experiments.

1. Fischer, Ernst: The Effect of Faradic and Galvanic Stimulation Upon the Course of Atrophy in Denervated Skeletal Muscles, Amer. Jour. Physiol. **127**:605, 1939. (a) Solandt, D. Y.; DeLury, D. B., and Hunter, J.: Effect of Electrical Stimulation on Atrophy of Denervated Skeletal Muscle, Arch. Neur. and Psych. **49**:802, 1943. (b) Gutmann, Ernest, and Guttman, Ludwig: Effect of Electrotherapy on Denervated Muscles in Rabbits, Lancet **1**:169, 1942. (c) Hines, H. M.; Thomson, J. D., and Lazere, B.: Physiologic Basis for Treatment of Paralyzed Muscle, Arch. Phys. Ther. **24**:69, 1943. (d) Kosman, A. J.; Wood, E. C., and Osborne, S. L.: Effect of Electrical Stimulation Upon Atrophy of Partially Denervated Skeletal Muscle of the Rat, Amer. Jour. Physiol. **154**:451, 1949.

2. (a) Grodins, F. S.; Osborne, S. L.; Johnson, F. R., and Ivy, A. C.: Stimulation of Denervated Skeletal Muscle with Alternating Current, Amer. Jour. Physiol. **142**:216, 1944. (b) Grodins, F. S.; Osborne; S. L. Johnson, F. R., and Arana, S., and Ivy, A. C.: The Effect of Appropriate Electrical Stimulation on Atrophy of Denervated Skeletal Muscle in the Rat, Amer. Jour. Physiol. **142**:222, 1944. (c) Kosman, A. J.; Osborne, S. L., and Ivy, A. C.: The Comparative Effectiveness of Various Electrical Currents in Preventing Muscle Atrophy in the Rat, Arch. Phys. Med. **28**:7, 1947.

*** Model CD7, product of the Teca Corporation, New York.

resulted from muscle stimulation was elbow flexion. To minimize friction, the board on which the arm and forearm rested was covered with oil.

The tension developed by the contracting elbow flexors was measured by means of four strain gauges, arranged in Wheatstone bridge fashion on a steel bar (31 cm. x 2.5 cm. x 3 mm.), and recorded photographically with the aid of Heiland G-150 galvanometer. The resistance of each gauge (SR4, type A-1) was approximately 120 ohms, with 4½ volts applied to the ends of the bridge. The steel bar, which was fixed to the table at one end, had its long axis perpendicular to the long axis of the forearm, and touched the radial border of the forearm at a distance of 24 cm. from the elbow.

TABLE 1. — *Effect of Novocain Ion Transfer or Constant Current on the Tension Produced in the Elbow Flexors by Electrical Stimulation.*

Procedure	Control	Average Maximal Tension After Ion Transfer or Constant Current	Change	Average Change After Ion Transfer or Constant Current	"p" Value
Novocain to elbow flexors	2.4 lbs.	1.8 lbs.	—25%	—1.1 lbs.	<0.001
Novocain to triceps	1.4 lbs.	2.6 lbs.	+86%	+0.9 lbs.	<0.001
"Anodal current" to triceps	1.2 lbs.	2.9 lbs	+142%	+1.6 lbs.	<0.001
"Cathodal current" to triceps	1.6 lbs.	1.9 lbs.	+19%	+0.3 lbs.	<0.001

The average maximal tension refers to the peaks of the tension-frequency curves of Figures 1, 2, 3, and 5, respectively. The average change is obtained by taking the sum of the differences between tension before and after a procedure at each frequency studied, and dividing by the number of frequencies studied. The "p" value refers only to the significance of the average change in tension.

There were four groups of observations. In group A (eight observations) the effect of Novocain ion transfer to the elbow flexors was studied. The tension produced by electrical stimulation of the elbow flexors, at frequencies ranging from 2 to 360 cps., was first determined. Following this 1 per cent Novocain was applied to the elbow flexors by means of ion transfer (at the anode), with the cathode on the extensor surface of the forearm. The two electrodes used for ion transfer were approximately the same size (110 sq. cm.), with a current intensity of 20 milliamperes applied for 25 minutes. At the end of this period of time, there was, in almost all instances, numbness to pin prick under the anode. After the Novocain ion transfer was completed, the tension developed on electrical stimulation of the elbow flexors was again recorded. In each subject the current intensity used for the electrical stimulation was the same before and after ion transfer, and was just below the tolerance limit. In all observations but one, the current intensity used was approximately 10 milliamperes (RMS), while in one it was close to 20 milliamperes.

Group B (10 observations). The procedure was similar to that in group A, with the exception that Novocain ion transfer was now applied to the triceps and not to the elbow flexors. The cathode, with saline solution, was again placed over the extensor surface of the forearm. The tension developed on stimulating the elbow flexors electrically was determined before and after the ion transfer.

Group C (11 observations). In order to determine the specificity of the action of Novocain, the anode was again applied to the triceps, and the cathode to the forearm, but the solution at both electrodes was now physiological

saline. The current intensity and duration were the same as in the Novocain ion transfer experiments; namely, 20 milliamperes for 25 minutes. Tension in the elbow flexors on stimulating them electrically was determined before and after the application of "anodal current" to the triceps.

Group D (10 observations). The procedure was similar to that in group C, except for the application of the cathode to the triceps, and the anode to the forearm. The tension resulting from electrical stimulation of the elbow flexors was determined before and after "cathodal current" application to the triceps.

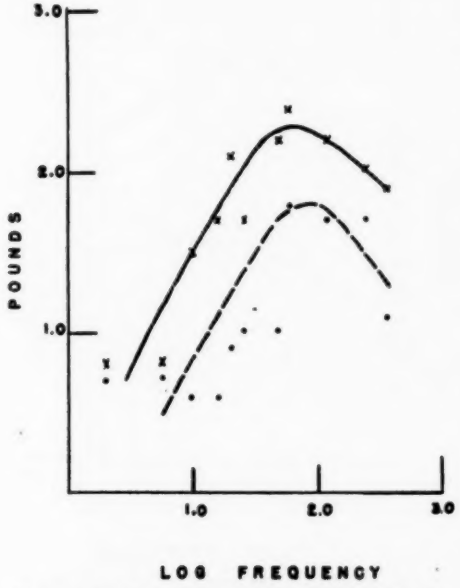

Fig. 1. — The effect of novocain ion transfer to the elbow flexors on the tension developed by the elbow flexors on electrical stimulation. The solid line indicates the tension developed before, and the broken line the tension developed after the ion transfer.

Results

Group A (figure 1). In the control observations, made before Novocain ion transfer to the elbow flexors, the average maximal tension recorded on electrical stimulation of the elbow flexors was 2.4 pounds, at a stimulating frequency of 60 cps. In one observation a tension of 13.1 pounds was reached. at a stimulating frequency of 60 cps. After Novocain ion transfer to the elbow flexors, there was a significant decrease in the amount of tension which could be produced by the elbow flexors when stimulated electrically at the same current intensity. This was true at every frequency studied, though the magnitude of the decrease was least at 2 and 6 cps. The average maximal tension reached after Novocain ion transfer to the elbow flexors was 1.8 pounds at 60 cps. The maximal tension achieved in one observation was 7.2 pounds at 60 and 120 cps.

These experiments were not designed to measure the tolerance to pain

quantitatively. It may be noted, however, that, despite the numbness to pin prick, there did not seem to be any increase in the amount of current which could be tolerated.

A statistical comparison of the tension obtained before and after Novocain ion transfer indicated that the average decrease in power over the entire frequency spectrum studied was 1.1 pounds, with a "p" value of <0.001, indicating a high degree of confidence in the validity of the difference observed.

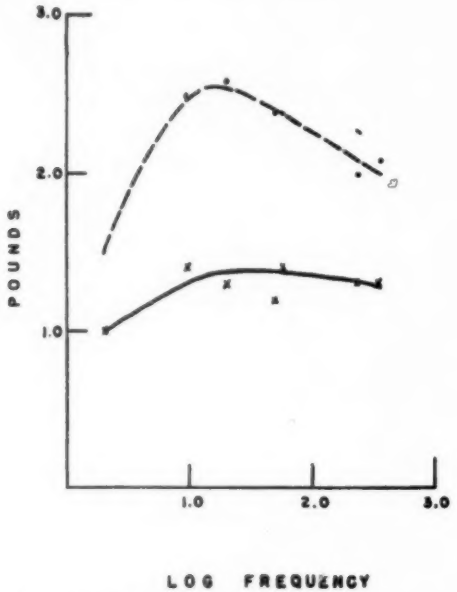

Fig. 2. — The effect of Novocain ion transfer to the triceps on the tension developed by the elbow flexors on electrical stimulation. The solid line indicates the tension developed before, and the broken line that developed after ion transfer.

Group B (figure* 2). Since the maximal tension recorded in the above series of observations, namely, 13.1 pounds, was far less than that which was obtained from the same muscle group on voluntary contraction (approximately 100 pounds in the male),[3] an attempt was made to study the role of the triceps when the elbow flexors were stimulated electrically. In order to do this Novocain was applied to the triceps by means of ion transfer to determine whether the muscle relaxation (shown to occur in the treated muscle in group A) of the elbow extensors would have any effect on the tension developed by the flexors on electrical stimulation.

Before Novocain ion transfer to the triceps, the average maximal tension in the elbow flexors following electrical stimulation was 1.4 pounds at 60 cps., with a maximal tension, in one observation, of 2.8 pounds at 10 cps. It is to be noted that more females were present in this group than in group

* Because of the wide range of frequencies studied, the logarithm of the frequency is plotted in the abscissa, making for a more convenient graphic demonstration.

3. Wakim, Khalil G.; Gersten, Jerome W.; Elkins, Earl C., and Martin, Gordon, M.: Objective Recording of Muscle Strength, Arch. Phys. Med. 31:90, 1950.

A. After ion transfer to the triceps, there was a significant increase in the tension developed in the elbow flexors on stimulating them electrically. The average maximal tension reached was 2.6 pounds at 20 cps., with a maximal value, in one observation, of 4.8 pounds at 50 and 60 cps.

Group C (figure 3). In order to determine how significant the role of the Novocain was in producing the effects noted above, the effect of the constant current was studied in two series of observations. In group "C" the anode was placed over the triceps, while in group "D" it was the cathode which was so applied.

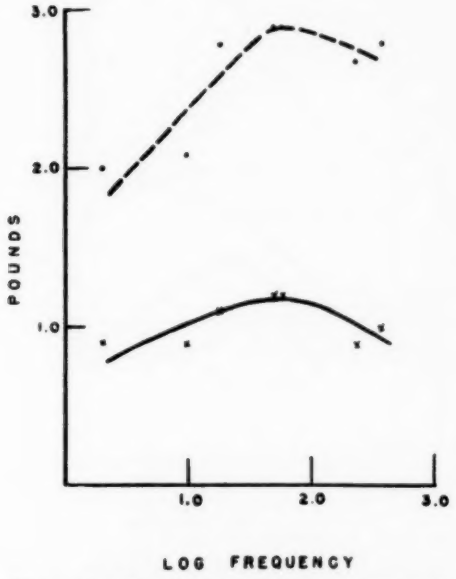

Fig. 3. — The effect of the application of constant current to the triceps on the tension developed by the elbow flexors on electrical stimulation. The anode was applied to the triceps and the cathode to the forearm. The solid line indicates the tension developed before, and the broken line that developed after the passage of the "anodal current."

When "anodal current" was applied to the triceps the amount of tension developed in the elbow flexors on electrical stimulation was significantly increased. In the control series, the average maximal tension recorded was 1.2 pounds at 50 and 60 cps., with a maximal tension, in one observation, of 1.9 pounds, at 50 and 60 cps. After "anodal current" * application to the triceps, the average maximal tension reached on stimulating the elbow flexors was 2.9 pounds, at 50 and 60 cps., with a maximum, in one observation, of 4.0 pounds at 60 cps.

In figure 4 the increases in tension in the elbow flexors following Novocain ion transfer to the triceps and "anodal current" to the triceps are recorded graphically. At each frequency studied, the effect of the "anodal current" was greater than the effect of the Novocain. The average difference

* "Anodal" and "cathodal" current, as used here, refer to the effect at the anode and cathode, respectively.

between the increase in tension in the elbow flexors produced by Novocain and by "anodal current" application to the triceps was 0.6 pounds, with a "p" value of 0.005. This suggests that the effect of the "anodal current" was significantly greater than the effect of the Novocain.

Group D. In this final series of observations the effect of the application of "cathodal current" to the triceps on the tension recorded when the elbow flexors were stimulated electrically was studied. There was an increase in tension in the flexors after "cathodal current" application to the extensors

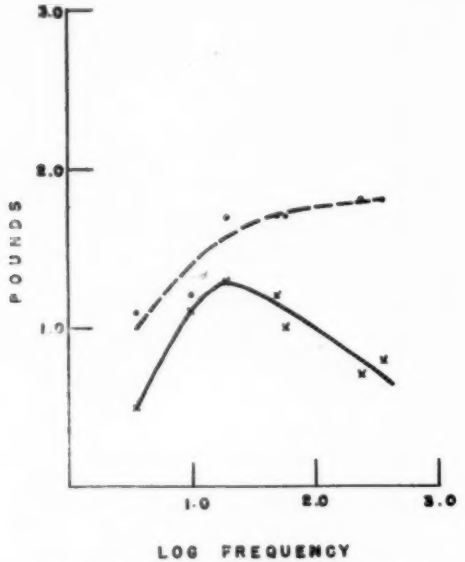

Fig. 4. — Comparison of the increase in tension in elbow flexors (on electrical stimulation) after novocain ion transfer and "anodal current" to the triceps. The solid line indicates the increase in tension after novocain ion transfer and the broken line the increase after the passage of the "anodal current."

(figure 5), but it was a much smaller one than the increase which resulted from "anodal current" application to the triceps. In the control observations the average maximal tension was 1.6 pounds, from 10 to 120 cps., with a maximal value, in one observation, of 2.3 pounds at 10 cps. After the application of "cathodal current" to the triceps, the average maximal tension reached was 1.9 pounds at 50 and 60 cps., with a maximum, in one observation, of 2.8 pounds at 50 cps.

The results obtained from the studies of the normal subjects are summarized in table 1. These indicate that the differences obtained are in all cases signficant, even when small.

A few observations were made on patients with nerve section and anterior poliomyelitis. Although these were too few in number to warrant drawing any generally valid conclusions, reference to them might be of some value, especially from the standpoint of future study.

In one patient with a denervated biceps due to brachial plexus injury,

the maximal tension developed in the elbow flexors on electrical stimulation was 0.6 pounds at 15 cps. This was far smaller than the tension which could be recorded from normally innervated biceps on electrical stimulation.

In three patients with anterior poliomyelitis, and involvement of the biceps, Novocain ion transfer to the elbow flexors caused a marked decrease in the amount of tension which could be developed in these muscles on stimulating them electrically. The average maximal tension recorded before the ion transfer was 1.9 pounds at 20 cps., while after the ion transfer it was 0.5

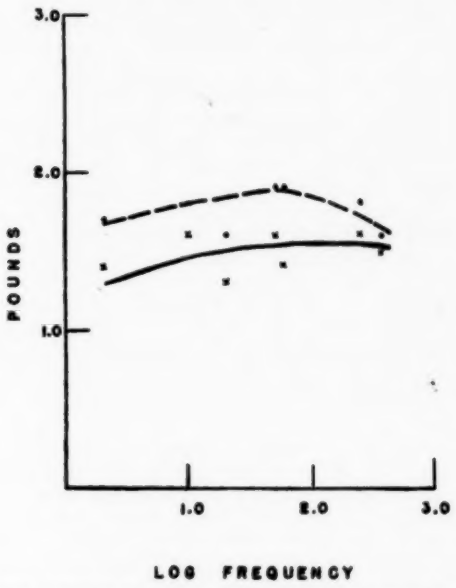

Fig. 5. — The effect of the application of constant current to the triceps on the tension developed by the elbow flexors on electrical stimulation. The cathode was applied to the triceps and the anode to the forearm. The solid line indicates the tension developed before, and the broken line that developed after the passage of the "cathodal current."

pounds at 20 cps. This result was qualitatively similar to that obtained in the normal subjects.

In four patients with anterior poliomyelitis, the effect of Novocain ion transfer to the triceps was studied. The results were not significant, differing markedly from those obtained in the normal subjects. At 60 cps., the frequency at which the average maximal tension was recorded, the control tension was 1.2 pounds, while after the ion transfer the tension in the elbow flexors was 1.5 pounds. At the other frequencies the difference was even smaller. In two patients there was a slight increase in elbow flexor tension following ion transfer to the triceps, in one there was no change, and in one there was a consistent decrease. This latter was the only observation made, in both normals and patients, in which the tension obtained on stimulating the elbow flexors electrically was decreased after ion transfer to the triceps. Repetition of the procedure in this patient produced almost identical results.

Comment

Eight curves were obtained (figures 1, 2, 3, 5) relating the tension developed in the electrically stimulated elbow flexors to the stimulating frequency. The average maximal tension was reached at 60 cps. in three series, at 50 and 60 cps. in two, at 50 cps. in one and at 20 cps. in one, while in one the tension was practically the same from 10 to 120 cps. Threshold voltage-frequency curves for vertebrate nerve and muscle show minima at approximately 80 to 100 cps.[4] The experiments described in the introduction have shown that, in the denervated muscle, maximal tension was obtained, on the average, when the stimulating frequency was approximately 25 cps. The results obtained in this series of observations are compatible with previous work, indicating that maximal tension in the normally innervated muscle of man was obtained at a frequency of approximately 50 to 60 cps.

It should be noted that the change in tension produced by the various procedures studied was small when compared with voluntary contraction; namely, of the order of 0.5 to 1.5 pounds. Yet, not only were these changes statistically significant, they were also large in comparison with the tension which could be produced by electrical stimulation, which was of the order of magnitude of 1.0 to 2.5 pounds. This study provided no explanation for the great difference between normal tension on voluntary contraction and tension produced by electrical stimulation.

Before analyzing the effects of Novocain ion transfer and of constant current alone on the tension developed in the elbow flexors on electrical stimulation, it should be pointed out that the phenomenon measured, namely, flexion of the forearm, is the resultant of two processes, contraction of the elbow flexors and extensors. Increased power of flexion may thus be due not only to more forceful contractions of the elbow flexors, but also to relaxation of the triceps. Novocain ion transfer to the elbow flexors resulted in a decrease in tension in the elbow flexors on electrical stimulation. Novocain ion transfer or "anodal current" to the triceps, however, resulted in an increase in tension in the elbow flexors on electrical stimulation. It is suggested, though not proved, that electrical stimulation of the elbow flexors results in simultaneous triceps activity, ipsilaterally, and that this triceps activity may be decreased by Novocain or direct current, especially "anodal."

When the effect of Novocain ion transfer to the triceps is compared with "anodal current" to the same region, it becomes apparent that Novocain, under the circumstances of this study, had little, if any, effect in producing muscle relaxation. This is not an unexpected result, in view of the fact that Harpuder[5] has demonstrated that ion penetration in ion transfer techniques is superficial. It is unlikely that Novocain penetrates to the muscle in large enough amounts to be of significance. In addition, Harvey[6] has shown that intra-arterial Novocain, in the cat, may act on end plates and motor-nerve ending terminals, decreasing the amount of tension which can be produced when the motor nerve is stimulated, but not affecting the contractile mechanism itself. This is indicated by the normal response to direct stimulation of muscle after the application of Novocain.

Summary

1. Tension developed in the normally innervated elbow flexors on electrical stimulation was studied at frequencies varying from 2 to 360 cycles

4. Coppée, Georges: Stimulation by Alternating Current, in Symposia on Quantitative Biology: Cold Spring Harbor, Long Island, New York, The Biol. Lab. 4:150, 1936.
5. Harpuder, Karl: Electrophoresis in Physical Therapy, Arch. Phys. Ther. 18:221, 1937.
6. Harvey, A. M.: The Actions of Procaine on Neuro-Muscular Transmission. Johns Hopkins Hospital Bulletin, 65:223, 1939.

per second. Maximal tension was developed, on the average, at stimulation frequencies of approximately 50 to 60 cps.

2. A decrease in tension on electrical stimulation could be produced by "anodal current." When such a current was applied to the elbow flexors the tension produced in these muscles on electrical stimulation was decreased, while on application to the triceps the tension in the elbow flexors was increased.

3. The increase in tension in the elbow flexors was slightly greater when "anodal current" was applied than when Novocain ion transfer was applied to the triceps, while with "cathodal current" to the triceps the effect was least.

Discussion

Dr. Robert Boyle (Fort Thomas, Ky.): This paper represents a well organized piece of research. It is well presented and most of the questions that arise while listening to it are answered in the comments.

The use of Pflügers old phenomenon of electrotonus to enhance the inhibition of the antagonist is a masterpiece of ingenuity. One wonders if this modality might be put to clinical use in the physiatrist's armamentarium.

Inasmuch as procaine (Novocain) is primarily a sensory nerve inhibitor, the question arises: What was the logical rationale for its use in an effort to get a stronger contraction using the same strength of stimulus?

Another question is: Will a stronger current, which might be better tolerated with procaine anesthesia, give a stronger contraction in these elbow flexors?

With all the fundamental work that has been accomplished by these physiologists working on the stimulation of denervated skeletal muscle, as yet, none has come up with the method of stimulating all of the motor units to give their most powerful contraction. What is there about voluntary contractions that makes them so much more efficient than electrically stimulated contractions? It cannot be the element of pain alone, because stimulation of denervated (sensory and motor) muscles still will not respond with maximal contractions equivalent to voluntary contractions. Does it have to do with the properties at the intact synapse in the cord? Certainly the inhibition of the antagonist by anelectrotonus seems to point in that direction.

It would appear that the work now being done by this group of men may rapidly lead to the physiological answer to these perplexing questions. While awaiting the answer, however, it would certainly be gross mistreatment if we did not use these modalities for treatment purposes in those cases in which they are indicated.

Dr. S. L. Osborne (Chicago): Dr. Gersten's statement that it might not be possible to use current intensities sufficient to produce vigorous muscle contractions clinically should have been credited to Doupe in England and Hines of Iowa, and not to our group at Northwestern.

The essayist states the only motion was elbow flexion. I think we should define what we mean by that term. Certainly a joint does not flex. I expect he means flexion of the forearm involving the biceps, brachialis, and triceps muscles.

The anode produces anelectrotonus. Hence might the decreased tension recorded in Group I be due to this phenomenon?

When procaine was applied to the triceps with a cathode to the extensor surface of the forearm — and again I presume he means this area (indicating) — the tension in the forearm increased. I wonder if this is not the same factor; that is, that the cathode causes catelectrotonus. Eighty per cent, however, seems to be a large increment.

In the third group the anode applied to the triceps gave an increase of 142 per cent. That is more difficult to explain. Certainly it isn't on the basis of Novocain by means of ion transfer. Harvey showed there is a blocking of the neuromuscular junctions when Novocain was used. However he used arterial injections directly into the muscle.

In the fourth group when the polarity of the electrodes were reversed, an increase of only 19 per cent in tension was noted but still statistically significant. It might be the anode depresses muscular irritability in this instance.

The increased tensions observed in these experiments might be due to lowered skin resistance. The nature of the problem forced the experimenter to take control measurements first; then it was necessary to apply the current for one-half hour; and finally to take the final measurements. Thus for the same current value one would secure a greater contraction of the muscle due to the lowered resistance. Finally, are some of these effects due to training?

Dr. Gersten (Denver, Colo.): Dr. Boyle wondered why procaine (Novocain) was used in this series of experiments. The question arose as to whether the amount of current which could be tolerated would be increased by ion transfer technique. In

other words, was superficial pain the limiting factor in the determination of current intensity which could be tolerated? It became evident, after a while, that the tolerance did not seem to increase as a result of Novocain ion transfer. As a matter of fact, it became evident that not only did the amount of current tolerated or the tension produced no increase, but that there was actually a decrease in tension; and then the question arose as to whether the effect of the procaine was specific or whether the effect was due entirely to current flow.

That brings us to Dr. Osborne's question as to just why or how direct current affected the tension produced. Why did it decrease the amount of tension? The electrode positioning was such that only one electrode was active on the muscles concerned at one time. First, when the anode was placed on the triceps, the cathode was applied not to the elbow flexors, but to muscles at a distance. There was no direct effect on the biceps, and as far as we can tell, the effects produced by the direct current were primarily effects on the triceps. Second, when Novocain was used, the anode was applied to the elbow flexors and the cathode to a distant muscle.

The greater effect of the anode can be seen as compared with the cathode. But, as will be shown in future work, the effect is not confined to irritability changes. The direct current, when flowing through the muscle, has effects which go beyond irritability and probably include direct contractility effects. These combine to produce a relaxation of the muscle.

ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

.·. EDITORIAL .·.

NOTICE TO CONGRESS MEMBERS

Please take notice that Section 3, Chapter 1, "Dues and Assessments" of the By-Laws of the American Congress of Physical Medicine reads in part as follows: "Membership dues in the Congress shall be payable January 1 annually and shall be in such sum as the Board of Governors shall determine, provided that notice of the Board's determination of dues for the ensuing year shall be published in either the October or November issue of the ARCHIVES OF PHYSICAL MEDICINE. The dues so determined by the Board shall be net dues accruing to the Congress and shall be transmitted to the Congress regardless of the amount of dues that may be collected by a society affiliated with the Congress in accordance with any arrangement that may be entered into between the Congress and the affiliated society for the collection and transmission of dues."

In accordance with this amendment the Board of Governors set the amount of dues for 1952 as Twenty Dollars ($20.00).

ANNUAL MEETING OF THE CONGRESS OF PHYSICAL MEDICINE

The twenty-ninth annual meeting of the Congress held in Denver provided those who attended with a happy combination of a comfortable stimulating climate in a beautiful vacation area with an interesting and informative scientific program. There was considerable variation in the type of scientific papers presented, in keeping with the traditions of the Congress. Our aim is to instruct general practitioners, with an interest in but no personal knowledge of physical medicine, in subjects of clinical value to them and at the same time to allow specialists in the field to present the results of their laboratory and clinical research. Although this diversity of purpose in the papers of the Congress and also those published in the ARCHIVES has been publicly deprecated, there appears to be considerable merit in having as great a variety of topics discussed as possible, in view of the fact that the membership is so heterogeneous in character. The ARCHIVES OF PHYSICAL MEDICINE has been criticized by some for publishing papers because they are more on a technician's level, and by others because they are too much of a technical and research character. These criticisms have been constantly considered by the Editorial Board, and in general it is felt that the character of papers is gradually tending more towards the research angle, directed toward the specialist in cognizance of the steadily increasing number of specialists who are members of the American Congress of Physical Medicine. Some articles will continue to be published for the general practitioner, who has less knowledge of technical details than the physical or occupational therapist, as long as such articles seem of value. It is hoped that the Program Committee will reconsider the recommendations of the Congress in

doing away with fifty per cent of the papers in view of the fact that the membership is made up of physicians with such diverse interests. Although many members would, of course, like to be able to hear all papers presented, proper arrangement of topics can be made so that a member would be able to select those papers from which he will profit most by listening as compared with those requiring study of the published article, and thus the general membership would receive maximum benefit from a full program such as has been presented in the past.

One of the significant innovations of the meeting was the presentation of the first John Stanley Coulter Memorial Lecture by Dr. K. G. Hansson, which we will continue to look forward to as one of the outstanding features of our meetings. We did not have a presidential address, as Dr. Bennett, our new President, was participating in the Second International Congress of Poliomyelitis in Copenhagen. In the future the President of the year will give the annual presidential address and conduct the entire business functions of the President at the annual meeting instead of splitting his activities between two meetings as has been the custom in the past.

The Educational Committee under the able chairmanship of Dr. Elkins is again to be congratulated on giving us a series of lectures and demonstrations of great value and of especial interest because of the widely acclaimed reputations of the speakers. This feature of the Congress meetings is of fundamental importance in achieving the educational aims of the organization.

We were fortunate to have at our banquet a distinguished professional pianist offer her services and to have a most interesting and inspiring address by the President of the University of Colorado, Doctor Stearns. The prizes for scientific exhibits and the Gold Key awards produced an element of suspense as usual, and the winners were happily acclaimed by the members. Everyone seemed to appreciate this opportunity to move the meeting westward and we may achieve the Coast before long.

In conclusion, the new President, Dr. Robert Bennett, is given a happy welcome as he assumes his duties for the coming year, and all regret that he could not be acclaimed in Denver. Success for him and the Congress is envisioned under his capable guidance.

AWARDS OF MERIT BY THE AMERICAN CONGRESS OF PHYSICAL MEDICINE FOR THE YEAR 1951

The Committee on Gold Key Awards announced through its Chairman, Dr. Walter M. Solomon, the following recipients:

HOWARD A. CARTER, Chicago, Illinois, in recognition of his contributions to the advancement of the science and art of Physical Medicine and particularly in recognition of his work as Secretary of the Council on Physical Medicine and Rehabilitation of the American Medical Association; to his devotion and tireless effort is due much of the accomplishment of that eminent group of pioneers.

STAFFORD L. OSBORNE, Chicago, Illinois, in recognition of his contributions to the advancement of the science and art of Physical Medicine and particularly in recognition of his basic and clinical research in Physical Medicine especially in the field of electricity.

WINFRED OVERHOLSER, Washington, D. C., in recognition of his contributions to the advancement of the Science and Art of Physical Medicine and particularly in recognition of his outstanding contributions in the

field of Occupational Therapy, which has gone far toward establishing a well merited place for Occupational Therapy in Psychiatry.

WALTER J. ZEITER, Cleveland, Ohio, in recognition of his contributions to the advancement of the science and art of Physical Medicine and particularly in recognition of his accomplishment as Executive Director of the American Congress of Physical Medicine; through his efforts, resourcefulness and leadership, the American Congress of Physical Medicine has reached its present place of highest eminence.

AWARDS TO SCIENTIFIC EXHIBITORS

The Committee on Awards for Scientific Exhibits presented through its Chairman, Dr. Robert W. Boyle, the following:

Gold Medal to Clair M. Kos, M.D., and Scott N. Reger, Ph.D., for the exhibit, "Rehabilitation in Oto-Laryngology."

Silver Medal to W. D. Paul, M.D.; R. E. Hodges, M.D.; J. I. Routh, Ph.D., and C. J. Wright, M.D., for the exhibit, "Studies in Rheumatoid Arthritis."

Bronze Medal to Duane Schram, M.D., for his exhibit, "A Physical Medicine and Rehabilitation Hospital."

MEDICAL NEWS

Members are invited to send to this office items of news of general interest, for example, those relating to society activities, new hospitals, education, etc. Programs should be received at least three weeks before the date of meeting.

American Congress of Physical Medicine Officers, 1952

Robert L. Bennett, M.D., Warm Springs, Ga., President.

Walter M. Solomon, M.D., Cleveland, President-Elect.

William B. Snow, M.D., New York, N. Y., First Vice-President.

William D. Paul, M.D., Iowa City, Iowa, Second Vice-President.

Howard A. Rusk, M.D., New York, N. Y., Third Vice-President.

Gordon M. Martin, M.D., Rochester, Minn., Fourth Vice-President.

A. B. C. Knudson, M.D., Washington, D. C., Fifth Vice-President.

Frances Baker, M.D., San Mateo, Calif., Secretary.

Frank H. Krusen, M.D., Rochester, Minn., Treasurer.

Walter J. Zeiter, M.D., Cleveland, Executive Director.

Dorothea C. Augustin, Chicago, Executive Secretary.

Other Officers Named for 1952

Dr. **Frederic J. Kottke** of Minneapolis was appointed to serve out the unexpired term on the Editorial Board of the ARCHIVES OF PHYSICAL MEDICINE which was created by the death of Dr. Richard Kovács.

Dr. **Arthur L. Watkins** of Boston was reappointed to serve a term of six years on the Editorial Board of the ARCHIVES OF PHYSICAL MEDICINE.

Dr. **Frank H. Krusen** of Rochester, Minn., was elected to succeed himself to serve a term of three years on the financial committee of the Congress.

Dr. **Earl C. Elkins** of Rochester, Minn., was appointed to serve a term of seven years on the Board of the American Registry of Physical Therapists, beginning January 1, 1952.

(*Continued on page 668*)

MARION GERTRUDE SMITH

MARION G. SMITH

On August 19, 1951, Miss Marion G. Smith died in Chicago, Illinois, after a short illness.

Miss Smith was born in New Brighton, Pennsylvania. She received her Bachelor of Science degree at Ohio State University in 1920. From 1922 to 1924 she was instructor in chemistry at Ohio State University and from 1924 to 1926 she was research assistant in the department of biophysics at Harvard Medical School. In 1930 she was appointed Executive Secretary of the American Congress of Physical Medicine. In 1935 she was appointed Registrar and Treasurer of the American Registry of Physical Therapists. In addition, she was Assistant Secretary and Treasurer of the American Society of Physical Medicine and the American Board of Physical Medicine and Rehabilitation.

Miss Smith's life was closely associated with the development of the field of physical medicine. At the time of her appointment the office at 30 North Michigan Avenue in Chicago was merely that of the American Congress of Physical Therapy — a small and unknown organization. With the advancement of the specialty of physical medicine more and more activity took place in that office until it served as the center for the two large professional societies — as well as the American Board and the American Registry. Her management of that office was accomplished with perfection and distinction. She knew everyone who was in any way associated with physical medicine and was most highly respected and loved by all. Her administrative ability at the annual meetings of the American Congress of Physical Medicine during the past many years was recognized as an outstanding achievement.

Her death is a great loss to physical medicine. Her presence and influence will be missed by everyone who knew her.

Medical News

(Continued from page 665)

New York Society of Physical Medicine

Stated Meeting, Saturday, October 13, 1951, at 2 P. M., New York State Rehabilitation Hospital, West Haverstraw, New York.

10:30 A. M. to 11:45 A. M., Inspection of Hospital.

12:00 Noon to 12:30 P. M., Business Meeting.

12:45 P. M. to 1:30 P. M., Luncheon.

2:00 P. M., Scientific Session.

Address of Welcome by Dr. A. J. Canning, Superintendent.

Panel Discussion on the Treatment of Anterior Poliomyelitis:

Bernard M. Halbstein, M.D.; Kristian G. Hansson, M.D.; Maurice Lenarsky, M.D.; John C. McCauley, Jr., M.D.; Daniel Sciarra, M. D.; Emil Smith, M.D.; William B. Snow, M.D.; Marvin A. Stevens, M. D., and Hart E. Van Riper, M.D. Morton Hoberman, M.D., Moderator.

A. C. S. Meeting

Twenty-six hospitals in San Francisco and East Bay communities and the medical schools of the University of California and Stanford University are planning clinics, demonstrations, postgraduate courses and other events for the surgeons and hospital personnel who will attend the 37th Clinical Congress and the 30th Hospital Standardization Conference of the American College of Surgeons, November 5 to 9 in San Francisco. Letterman Army Hospital surgeons are arranging a series of operative clinics which will be telecast, in color, to the Civic Auditorium. Extensive scientific and technical exhibits, registration, showings of medical motion picture films, hospital conferences, and a number of the official and scientific sessions will also be held in the Auditorium. The Forums on Fundamental Surgical Problems and some of the other sessions will be held in the Fairmont and Mark Hopkins hotels.

At the Convocation on the final evening, Friday, November 9, some 900 initiates will be received into Fellowship and several honorary Fellowships will be conferred. Other evening sessions will be as follows: Tuesday, Medical Defense Program, with Colonel William L. Wilson of Washington participating; Wednesday, the Fracture Oration, delivered by Sir Reginald Watson-Jones of London, and a Symposium on "Metabolic Disturbances during Surgical Care," and Thursday, discussions of radiation therapy, applications of radioactive isotopes, and the status of antibiotics. In addition, on the same evenings, there will be separate sessions for ophthalmologists and for otorhinolaryngologists. At morning and afternoon scientific sessions each day, subjects will be presented which will interest general surgeons and surgeons who do most or all of their work in one of the surgical specialties.

A conference on Cooperative Relationships in Hospital and Post-Hospital Rehabilitation of Veterans is to be held at the Veterans Administration Hospital, Hines, Illinois on Friday, November 2, 1951, from 9:00 a. m. to 4:00 p. m.

A number of outstanding speakers in the various fields of rehabilitation will take part in the panel and discussions.

Physicians and all other professional personnel are invited. There will be no registration or other fee.

LOUIS B. NEWMAN, M.E., M.D., Chairman,
Chief, Physical Medicine and Rehabilitation Service, Veterans Administration Hospital,
Hines, Illinois.

Personals

For his efforts in aiding the handicapped, Dr **Howard A. Rusk,** chairman of the health resources advisory committee of the National Security Resources Board, and trustee-at-large of the National Society for Crippled Children and Adults, was presented recently with the annual research award of the American Pharmaceutical Manufacturers Association.

Presentation was made in Boca Raton, Fla., by Dr. Martin Lasersohn, chairman of the association's research board, during the association's 44th annual convention. Dr. Lasersohn said the award was given Dr. Rusk for his "devotion to a phase of medicine and a social enigma once dismally neglected." The phase to which Dr. Lasersohn referred is the treatment of the handicapped in the period preceding their employment by business and industry.

In his acceptance speech Dr. Rusk pointed to the great untapped source of manpower — the handicapped — that "could become employable if they had the opportunity for modern rehabilitation and training."

Dr. Rusk recounted the great strides made by medicine in increasing longevity. However, he pointed out, this "brought about an increase in chronic disease and resultant physical disability." He called the problems of chronic disability "the nation's greatest drain on our manpower."

Dr. **Frank H. Krusen,** head of the Section on Physical Medicine and Rehabilitation, Mayo clinic, was guest speaker at the recent annual meeting of the health division of the Community Welfare Council of Milwaukee, Wis.

Dr. Krusen, a counselor in physical medicine to the National Society for Crippled Children and Adults, spoke on "A Community's Rehabilitation Service and Center."

Annual Convention of National Society

The vital role of the crippled in the national defense effort will share the spotlight with advances in treatment and training of crippled children at the annual convention of the National Society for Crippled Children and Adults, the Easter Seal Agency, in Chicago's Palmer House, October 3-5.

Nationally known authorities in both fields will be featured speakers on a program which will mark the National Society's 30th year of service to the crippled, according to an announcement by Lawrence J. Linck, executive director.

An actual clinic demonstration of handicapped workers in industry will be conducted by Dr. George G. Deaver, past-president of the American Academy for Cerebral Palsy, and professor of Physical Medicine and Rehabilitation, New York University College of Medicine.

A special feature of this year's convention will be a series of professional seminars covering the subjects of diagnosis of cerebral palsy in the young adult, daily living activities for the crippled child, physical therapy, occupational therapy, speech therapy, social and emotional problems, and special education.

Participants in the seminars will include Dr. Meyer A. Perlstein, chief, Children's Neurology Clinic, Cook County Hospital, Chicago; Dr. George G. Deaver; Dr. Winthrop M. Phelps, Children's Rehabilitation Institute, Cockeysville, Md.; Harold B. Westlake, Ph.D., director of the Speech Clinic, Northwestern University; Dr. Doris Phillips, associate professor in child psychiatry and director of the Child Guidance Clinic, University of Pittsburgh; Edna M. Blumenthal, director of rehabilitation, North Carolina Hospital for Cerebral Palsy, Durham, N. C.; Ruth Brunyate, director of occupational therapy, Children's Rehabilitation Institute, Cockeysville, Md.; Berneice R. Rutherford, director of the Rehabilitation Center of St. Paul, St. Paul, Minn., and Margaret Lefevre, coordinator, Cerebral Palsy Center, Savannah, Ga.

N Y U Institute Plans Advanced Rehab Courses

The Institute for Rehabilitation and Physical Medicine in New York is offering two courses this fall that will be of special interest to rehabilitation personnel. A three week seminar in physical rehabilitation methods for registered nurses will be presented from October 29 through November 16 for five days each week. Tuition for the course is fifty dollars.

An advanced course in physical rehabilitation methods for physical therapists will be presented at the Institute from November 26 through December first. The course, which carries four points of credit, has a tuition charge of sixty-two dollars.

Each course will be given two more times later in the school year, during the spring semester. Complete information can be secured from Miss Edith Buchwald, Director of Rehabilitation Courses for Physical Therapists, Institute for Rehabilitation and Physical Medicine, 325 East 38th Street, New York 16, N. Y.

Polio Course in California

The Orthopedic Hospital of Los Angeles announces a short course on the team approach to the total treatment of the poliomyelitis patient, to be held from October 22 to 26, 1951. Open to physicians, occupational and physical therapists and nurses, the program will present all phases of patient care with emphasis on coordination of services. For further information write to Miss Miriam Thompson, OTR, Director of OT, Orthopedic Hospital, 2400 South Flower Street, Los Angeles 7, California.

AAAS Philadelphia Meeting, December 26-31, 1951

The 118th Meeting of the American Association for the Advancement of Science, the annual meeting for 1951, will include programs of all 18 of the Association's sections and about 45 participating societies. Programs of particular interest to those in medicine and experimental biology include:

Sectional Programs

Section C-Chemistry: Eleven sessions, including one on Medicinal Chemistry; two on Forensic Sciences, and two on Reaction Mechanisms.

Subsection Nm-Medicine: Four-session symposium on Abnormalities of Lipid Metabolism, with special reference to arteriosclerosis.

Subsection Nd-Dentistry: Three sessions, including a symposium on Fluoridation as a Public Health Measure.

Section O-Agriculture: Four-session symposium, Public Health Aspects of Soil Science.

Oak Ridge Institute of Nuclear Studies: Two-session symposium on Radioisotopes in Medicine.

Society for Research in Child Development and AAAS Section N: Symposium, Biochemistry of Nutrition in Human Growth.

Special Sessions

A special feature of the meeting will be the *AAAS Annual Exposition of Science and Industry*: The Association's Exposition again will total about 150 booths and will fill the arena of Philadelphia's Convention Hall. In addition to those of leading publishers, instrument makers, and suppliers of scientific materials, there will be technical exhibits by prominent manufacturers of pharmaceuticals and biologicals. On or near the exhibit area will be the Fifth Annual International Photography-in-Science Salon and the AAAS Science Theatre which, almost continuously, will show the latest foreign and domestic scientific films.

Easter Seal CP Center

The child cerebral palsy victim in Wisconsin is going to have a special home at the University of Wisconsin. The regents approved the creation of an "Easter Seal Cerebral Palsy Center," set up especially for the treatment of spastics. The center will operate for three years at Wisconsin General Hospital with $15,000 provided each year by the Wisconsin Association for the Disabled.

Dr. Coon said that the money will be used to provide specialized technicians and therapists to increase the facilities now available at the Orthopedic Hospital, and also to set up.

1. A coordinated program of examination, evaluation, treatment, occupational and physical therapy, and after-care;

2. A school program open to children who have been through the evaluation and treatment phases and no longer require hospitalization, as well as for those in the hospital;

3. A training program for the parents of cerebral palsy children to assist in care and treatment after the children return to their homes, and

4. A specialized program for training personnel interested in occupational therapy, physical therapy, and social work programs for the cerebral palsied children.

The program also visualizes an adequate follow-up program to provide continued treatment and schooling, eventually leading to establishing local centers throughout the state, Dr. Coon said.

"Faced with the lack of the required specially trained personnel for such a program, it is a mutually welcomed opportunity that brings the medical school into the picture and makes possible this joint activity of such vital human interest."

Kenneth Svee, executive secretary of the association, and his co-worker Miss Mary Towne, will assist in the direction of the center. Dr. William S. Middleton, medical school dean, has appointed a committee headed by Dr. Mabel S. Masten to coordinate the various departments of the medical school and other departments of the university.

Dr. Henry Okagaki, orthopedic hospital staff member who has had special training in cerebral palsy care, and Dr. Harry Bouman, director of the physical therapy and occupational therapy schools, will further implement the program.

Congress Participants in National Society Meeting

George G. Deaver, New York, N. Y., presented a Clinic Demonstration entitled "At Work";

Jessie Wright, Leetsdale, Pa., participated in the subject "Facts and Figures on Cerebral Palsy."

The following Instructional Seminars were presented:

"Diagnostic and Other Medical Aspects of Cerebral Palsy" by **Meyer A. Perlstein,** Chicago, Illinois;

"Rehabilitation Activities of Daily Living for the Crippled Child" by **George G. Deaver,** New York, N. Y.

World Confederation for Physical Therapy

At the organizational meeting of the World Confederation for Physical Therapy held earlier this month in Copenhagen, Denmark, Miss Mildred Elson was elected the first president of this new international organization. Attending the meeting were 150 physical therapists representing 15 different nations. Objectives of the new organization are to provide for an international exchange of technical data on physical therapy, encourage standardization of training and certification in the various nations, and develop methods whereby each of the nations may recruit and train more therapists.

BOOK REVIEWS

VOLUNTARY PREPAYMENT MEDICAL CARE PLANS. Revised 1950. Paper. Pp. 142. Council on Medical Service, American Medical Association, 535 North Dearborn Street, Chicago 10, 1951.

This is the 1951 edition of the brochure put out by the Council of Medical Service Service of the A. M. A. It contains the latest detailed information of the 94 prepayment plans in the United States and Canada. The growth of these plans during the past year has been most encouraging. The total enrollment in medical society plans as reported to the Council on December 31, 1950 was 19,879,600. This shows continued support of these plans.

This brochure supplies the latest information about the plans and should be a real service to those individuals who are interested in this phase of medical economics.

PHYSIOLOGY OF SHOCK. By *Carl J. Wiggers*, M.D., Sc.D., F.A.C.P., Professor of Physiology and Director, Department of Physiology, School of Medicine Western Reserve University. Cloth. Price, $5.00. Pp. 459, with 56 illustrations. The Commonwealth Fund, 41 East 57th Street, New York *22*, 1950.

This book offers a detailed consideration of the multifarious dysfunctions observed in experimental animals after thermal, mechanical, and chemical injuries; the techniques are described on pages 102 to 113. They do not make pleasant reading, and the author unfortunately does not offset them with either an effective statement of the painful dilemmas that have, in the past, confronted the physician who must treat a patient in shock or a good summary of the therapeutic implications of recent experimental work. Research on this subject has now gone on for many decades, and the reader might well expect an answer to the questions whether a patient in shock should be kept warm or should be allowed to throw off his coverings, whether epinephrin is always indicated or whether there are times when its use would be disastrous. To the reader who is unaware of the urgent and difficult nature of these problems, the motivation of all this sanguinary research is not immediately clear, and the allusion (page 9) to the first World War as having afforded extraordinary "opportunities" for studying shock in man sounds like an inversion of the normal viewpoint.

There is, in fact, reason to fear that the thinking that underlies much of this work is unclear and that communication among investigators is imperfect. "Shock" is an excellent example, semantically, of a number of words that are widely used by the public in a loose way but have been adopted into the scientific vocabulary with a highly arbitrary special meaning. This sets the stage for a tragedy of misunderstandings, but in the present instance things are worse because even within the scientific vocabulary the word is misused in a variety of ways. This is instanced by the statement (page 68) that "several hours must elapse before it can be determined whether a patient with clinical signs of shock is or is not in a state worthy of being called shock."

The index contains five entries under "Definition of shock," but the only thing to be found resembling a formally logical definition is a phrase ascribed to Harkins (page 221). This, upon study, proves to be not a practical definition but the summary of a theory.

Because of the wealth of technical detail and references to previous publications, the book will be useful to those doing research in this field, especially in its cardiovascular aspects.

BRAIN METABOLISM AND CEREBRAL DISORDERS. By *Harold E. Himwich*, M.D., Chief Clinical Research Branch, Medical Division, Army Chemical Center, Maryland. Cloth. Price, $6.00. Pp. 451, with 52 illustrations. The Williams & Wilkins Company, Mount Royal and Guilford Avenues, Baltimore, Md., 1951.

This book is a very important publication. It is the result of a large amount of work by the author and covers a great deal of literature which up to now has not been successfully collected. There are more than a thousand references in the book, more than fifty of which are the author's own. Dr. Himwich divides his book in two parts. The first deals with the energetics of brain metabolism while the second part deals with patterns of nervous activity. In the first part he introduces the energetics of brain metabolism and the mechanisms which maintain carbohydrate supplies of the brain including mechanisms which maintain brain mechanism during hypoglycemia. The effects of the cerebral circulation are discussed and this part of the book ends with a discussion of therapeutics and their application to brain metabolism. For the field of physical medicine the second part of the book is probably the most important because it contains a discussion of somatic and autonomic functions of the nervous system studied through symptoms of hypoglycemia and acute anoxemia. One is particularly tempted to draw some conclusions from this in relation

to the pathology of bulbar poliomyelitis and the book is particularly valuable in this respect because it gives all the biochemical evidence that is not usually easily available to the poliomyelitis investigator. All in all, Dr. Himwich has performed a real service by reviewing the extensive literature in the field in book form.

CLINICAL HEART DISEASE. By *Samuel A. Levine*, M.D., F.A.C.P., Clinical Professor of Medicine, Harvard Medical School; Physician, Peter Bent Brigham Hospital, Boston; Consultant Cardiologist, Newton-Wellesley Hospital; Physician, New England Baptist Hospital. Fourth Edition. Cloth. Price, $7.75. Pp. 556. W. B. Saunders Company, 218 West Washington Square, Philadelphia 5, 1951.

This book in its previous editions has demonstrated its value as a practical guide for the general practitioner and internist confronted with the problem of treating the increasing number of patients suffering with heart disease. Its reporting of the latest advances in knowledge of heart physiology as determined by cauterization and modern electrocardiographic techniques make this new edition of value. The chapter on medico-legal aspects of heart disease is of especial interest to physiatrists, but there is no detailed discussion of rehabilitation.

This is a well written, authoritative book for cardiologists, internists, general practitioners, and students.

DIMENSIONAL ANALYSIS FOR STUDENTS OF MEDICINE. By *Harold A. Abramson*, M.D., Assistant Clinical Professor of Physiology, Columbia University, New York. Paper. $1.00. Pp. 41. Josiah Macy, Jr., Foundation, 565 Park Ave., New York 21, 1950.

This book is a most earnest attack, from a special angle, upon the most pressing human problem of this age: How to improve communication and prevent the misunderstandings that divide humanity. While mathematicians, physicists, and engineers publish volumes of definitions, and feel well repaid for their efforts by the consequent saving of time, money, and irritation, the medical vocabulary continues to be obnubilated by all sorts of ill-advised words and phrases. The nomenclature used by hematologists has long furnished instances of this, but innumerable examples can easily be found in every branch of medicine—phrases like "aleukemic leukemia," "combined degeneration," "traumatic shock," "trophic nerve," and "verbal artificial respiration." As Abramson hints in his remarkably temperate introduction, this confusion is particularly unfortunate as it affects psychiatry, and those who control the weapons of hostility and those who understand the motivation of hostility within man must meet on common ground as soon as possible.

The author's contribution is an effort to clarify the medical student's thinking about certain terms used in the medical sciences. By following his suggestions, a careful student will find it possible to avoid many fallacies. Those who are well grounded in mathematics will find the book interesting and helpful. Unfortunately, it is not completely free from misprints, and on page 19 the author finds it necessary to introduce the notation of differential calculus. Since this subject is several jumps beyond high school algebra, the topics in which it occurs might well be segregated. This book will be inspiring in the hands of some teachers, but can become an instrument of torture in the hands of others. It should be used with discrimination.

THE PROCEEDINGS OF THE SECOND CLINICAL ACTH CONFERENCE, Volume I — Research and Therapeutics — Volume II. *John R. Mote*, M.D., Editor. Cloth. Price, $17.00. Pp. 551 with illustrations, Volume I; Pp. 715 with illustrations, Volume II. The Blakiston Company, 1012 Walnut Street, Philadelphia 5, 1951.

These two volumes report the conference held on December 8th and 9th, 1950. One hundred and two papers were presented. The first volume deals primarily with research showing the effects of adrenal corticoids on the various systems. The latest physiological and metabolic studies are given, bringing out the tremendous advances that have been made in elucidating the ACTH and cortical functions. The subheadings in this volume are as follows: general adrenal cortical physiology and adrenal cortical steroid secretion and excretion, kidney and electrolytes, nitrogen metabolism, carbohydrates and fat metabolism, vitamin metabolism, adrenal gland and hemopoietic system, and fundamental acute inflammatory reaction.

The second volume contains the articles on the clinical aspects of ACTH. This volume reports not only on the treatment of the diseases and disorders that are known to be benefited but numerous others in which ACTH has been shown to be effective. The latest developments in methods of administering the drug are also given. The subheadings for this volume are metabolic or physiologic defect, hematopoietic diseases: malignancy in general, surgical use, infectious disease and liver disease, hypersensitivity, toxins and toxic materials, inflammatory diseases of unknown etiology, and collagen disease.

The publisher has wisely included much of the informal discussion that occurred at the conference. These remarks are most valuable and bring out ideas that are not always found in the articles themselves.

Here in two volumes is the very latest information on the adrenal gland. Just a year ago the first conference on ACTH was reported in one small volume — this year's conference requires almost 1300 pages, demonstrating the tremendous amount of investigative work that has been done

to clarify the role of the adrenal gland in human physiology. The clinical use of this drug has had an additional year's trial resulting in better and more rational methods of administration to those diseases known to be controlled by the drug and to other diseases and disorders in which it may alter their course. This is truly the "new era of medicine."

LEG AMPUTEE: PRE-PROSTHETIC TRAINING. *Signe Brunnstrom* and *Donald Kerr.* The Kessler Institute for Rehabilitation, Pleasant Valley Way, West Orange, N. J., 1951.

This is the third booklet in a Rehabilitation Series. It briefly and concisely covers the early after-care of amputations, bed exercises, bandaging the stump, use of crutches, care and strengthening of the remaining leg, hopping technique and general conditioning and specific stump exercises. The book is well illustrated to emphasize important points and should be in the library of everyone interested in amputees and rehabilitation.

HANDBOOK OF PEDIATRIC MEDICAL EMERGENCIES. By *Adolph G. DeSanctis,* M.D., Professor of Pediatrics and Chairman of the Department of Pediatrics, Post-Graduate Medical School, New York University-Bellevue Medical Center; Director of Pediatrics, University Hospital, New York University-Bellevue Medical Center; Director of Pediatrics, Gouverneur Hospital, New York City, and *Charles Varga,* M.D., Instructor in Pediatrics, Post-Graduate Medical School, New York University-Bellevue Medical Center; Assistant Attending Pediatrician, University Hospital, New York University-Bellevue Medical Center; Assistant Visiting Pediatrician, Gouverneur Hospital, New York City. Cloth. Price, $5.00. Pp. 284, with 51 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1951.

In this book the authors, with the help of eleven other contributors, have assembled the results of many years of experience with every imaginable kind of pediatric emergency. The successive chapters deal with cardiovascular, gastrointestinal, genitourinary, neurological, and miscellaneous emergencies. The last-named include drowning, poisoning, bites, and various types of shock. Especially valuable are two alphabetical tables in the appendix indicating the poisonous constituents of various chemical mixtures, from ABD Pills to Zotox, used in the industries or in the home. The authors have made every effort to answer questions in concrete and quantitative terms, and the chapter on "Pediatric Procedures" deserves special commendation for many illustrations clearly showing details of technique.

Since this is a first edition, it may be assumed that the authors will welcome suggestions for the improvement of future printings. When masses of information are collected from different sources, inconsistencies are likely to occur. An instance appears on pages 130 and 131, where oils are warned against in the case of naphthalene yet recommended in the case of phenol for the same reason. Incidentally, the obsolescent common name for phenol, carbolic acid, is not given.

A more general difficulty arises from the indefiniteness of the concept of an "emergency." An emergency used to be something that impelled people to toss the chinaware out of the windows and then rush out of the house carrying the frying pan to safety wrapped in a blanket. The reader of this book, however, is expected to remain cool and clear-headed, to estimate the patient's body area (page 232) by working a table in the appendix backwards (page 271),to find his way through a footnote to a footnote (page 233), to prepare without hesitation a molar sodium lactate solution, to interpret without difficulty such abbreviations as "mg.5 mEq." (page 233), to know exactly how much of what to use in making up "isotonic saline," to understand how phosphorus can have a valence of 1.8 (page 271), to know what a "repair solution" is (page 30), and to think equally fast in cubic centimeters, milliliters, and pints (page 30). And his faith must remain unshaken on learning that forcing fluids (page 37) sometimes is just as effective as withholding them entirely. If the authors will clarify some of these obscurities, the book will be appreciated by the physicians in general practice as well as by the pediatricians for whom it is intended.

ADVANCES IN BIOLOGICAL AND MEDICAL PHYSICS. Edited by *John H. Lawrence* and *Joseph G. Hamilton,* University of California, Berkeley, California. Volume II. Cloth. Price, $7.80. Pp. 348, with illustrations. Academic Press, Inc., 125 East 23rd Street, New York 10, 1951.

The second volume of the Advances in Biological and Medical Physics deals mainly with problems in biological application of radio isotopes. There are other chapters, however, on molecular exchange and blood perfusion through tissue regions, and atherosclerosis. Particularly, the first of these two chapters, by Jones of the University of California, is of very considerable physiological and clinical interest. The very short article by Gofman on atherosclerosis gives a very excellent review of the beginning research in this clinically important field. The other seven articles in the book all deal with nuclear physics as applied to biological and medical problems. An introductory chapter by Curtis on the biological effect of radiation is followed by articles by Heidelberger on the application of carbon isotopes to a study of animal metabolism, by Heller on radioautographs and by Brues on the carcinogenic effect of radiation. Articles of particular interest are those on in vivo studies with radioisotopes and the one on radioactive isotopes in clinical diagnosis. The latter is an up-to-date review of the growing material which is becoming available clinically. The

final article is on radioactive sulfur and its applications in biology. It is interesting to note that of the nine articles in this book, five originate from the University of California at Berkeley and two from the College of Physicians and Surgeons of Columbia University, while the University of Wisconsin and the Argonne National Laboratory are presented with one paper each.

A.M.A.'S PRIMER ON FRACTURES. Prepared by Special Exhibit Committee on Fractures in Cooperation with Committee on Scientific Exhibit of American Medical Association. Sixth edition. Cloth. Price, $2.00. Pp. 109, with 48 illustrations. Paul B. Hoeber, Inc. (Medical Book Department of Harper & Brothers), 49 East 33rd St., New York 16, 1951.

This book is well known and this issue is the sixth edition. Various fractures are discussed and treatment given in concise, brief form, with adequate illustrations covering points emphasized in the discussion. The book is intended for ready-at-hand use by students and practitioners. It deserves a place in the intern's library and in that of all physicians who come in contact with fractures.

METHODS IN MEDICAL RESEARCH. Vol. IV. By *M. B. Visscher,* Editor-in-Chief. The Year Book Publishers, Inc., 200 East Illinois Street, Chicago.

This is a compact volume which well fulfills the purpose expressed by the editor, viz., to improve the availability of reliable information regarding working methods for use in medical research. The scope of this fourth volume of the series includes histochemical staining methods, fluid and electrolite distribution, gastro-intestinal pressures, innervations and secretions and tissue culture methods. The techniques are presented concisely, with the detail necessary for practical application. Presentations include more recent techniques, such as the use of radioactive sodium and chlorine in the determination of extracellular fluid and radioactive tracers and phase microscopy in tissue culture studies. The volume is a valuable addition to this series and through the clarity of its presentation should prove a useful addition to technical literature concerning medical research.

THE VITAMIN B COMPLEX. By *F. A. Robinson,* M.Sc. Tech. (Manchester). LL.B. (London), F.R.I.C. Price, $9.00. Cloth. Pp. 688. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1951.

The Vitamin B complex has assumed great clinical importance because of its demonstrated value in preventive medicine and suggested value in a multitude of symptom complexes and diseases. Almost all practicing physicians will have call to prescribe some or all of this complex and hence should have some interest in this book as a reference. Its primary value, however, is as a convenient summary of our present knowledge derived from laboratory data. All research workers in the field should appreciate this compilation of all the important work in the field and the accompanying bibliographic data.

PHYSICAL MEDICINE ABSTRACTS

Suction Socket: Proper Selection of Patients for Above-Knee Artificial Leg. Charles O. Bechtol.

J. A. M. A. **146**:625 (June 16) 1951.

The purpose of this paper is to present facts of clinical importance in the prescription and fitting of the suction socket above knee artificial leg. The suction socket has been shown to be advantageous as a fitting method for most above knee amputees. The actual fitting and alignment of a section socket leg involves special problems of functional anatomy and gait. Four subjects of clinical importance are discussed: (1) The time required for the fitting of the suction socket; (2) the types of stumps in which difficult fit may be expected; (3) the type of surgical technique in amputation which produces a stump most favorable for fitting the suction socket and (4) the postoperative care and preparation for the fitting of a suction socket. Sutures should be removed at the end of the tenth day after the operation. During these ten days the patient should lie on his face in bed at least one hour a day to prevent the beginning of a flexion contracture of the hip. After removal of the sutures, the stump should be wrapped with an elastic bandage. This wrapping must cover the end of the stump by means of reverses, and it must come up to the inguinal fold in front of the leg and the gluteal fold behind, so that the subcutaneous tissues of the leg will be of uniform thickness. If only the lower portion of the stump is wrapped, the fitting of a suction socket will be considerably more difficult. In order to maintain the position of the wrapping high at the top of the stump, it is necessary to put on a spica type of bandage with several turns taken about the waist and the top of the stump in a figure of eight. The purpose of the wrapping with an elastic bandage is to prevent the excessive accumulation of subcutaneous fat. The bandage does not interfere with development of the muscles. The stump should be bandaged night and day. The bandage may be removed during exercising or bathing of the stump. The muscle exercises are divided into two groups: first, those involving the muscles of the hip which have not been disturbed by the amputation; second, those mobilizing muscles of the thigh that have been divided in the process of amputation. When the sutures are removed, active exercise of the hip muscles should be started. Extension and abduction should be particularly stressed, and the hip should be carried through a full range of active motion in all directions. As soon as the end of the stump is nontender and able to tolerate a cuff, exercises against resistance should be started. It is of great importance in older amputees to prevent the formation of hip flexion contracture. The hip flexors should be stretched daily with the patient lying on his face and the stump placed on a pillow. Exercise of the severed muscles of the thigh should also be started ten days after the operation. These should consist of alternate contractions of the extensor and flexor muscles of the knee. At first, no attempt should be made at vigorous contractions, because of pain and the possibility of disrupting some of the muscle sutures. At the end of six weeks, vigorous contractions of these severed muscles may be started.

Flexion Treatment of Low Back Pain. William L. Waldrop, and Howard B. Shorbe.

J. Oklahoma M. A. **44**:138 (Apr.) 1951.

Treatment of low back pain is a matter of management rather than that of specific treatment. The principle of the treatment by the flexion method is to correct the lordosis and maintain the correction. Its proper use requires diligent cooperation of the patient and also constant attention by the physician. The patient must understand his condition and the treatment: one of the most important parts of the treatment is the teaching of the patient. An articulated skeleton or x-rays are very valuable for this purpose. The program utilizes various steps which are used or left out as suits the needs of the individual patient. The entire treatment is very natural for the patient. Observation of any audience shows many people flexing the lumbar spine by sitting with legs crossed, their feet up, or their knees resting on the back of the seat in front of them. Brass rails were placed in front of bars to permit flexion of the lumbar spine during prolonged standing. Rest is the most important of all. Severe cases are placed on complete bed rest in a double Gatch bed with the thighs flexed constantly at 45 degrees and the head of the bed elevated for comfort. The buttocks lay on the incline with the thighs and the lumbar spine at the depth of the "V" made by the bed. Knees may be flexed as comfortable. Traction is applied by means of a canvas girdle about the sacral and trochanteric regions. Medication is used as necessary. Some form of heat is used routinely. Massage is of limited early value, but may be more beneficial later. In some cases a flexion cast is beneficial, but it must be applied correctly and fit well. A brace is not required commonly. Exercises are designed to stretch the tight back extensors and hip flexors, and to strengthen the abdominals and gluteals. The latter two groups are the flexors by the pelvis. To strengthen the abdominals the patient lies flat on his back and draws the thighs up on the chest, one at a time and then

both together. This also stretches the back muscles. To stretch the hamstrings he uses the same position except that the knee is extended with the leg straight upward. To strengthen the gluteals the patient lies flat on his back with hips and knees flexed, and lifts the hips while holding the lumbar spine down flat. The most important part of the entire treatment is teaching the patient actively to correct his poor posture and to prevent positions and activities which cause him poor posture. The basic tenets of the method require the patient to correct his bad postural habits and then to maintain good posture. If he resumes his old lordotic posture, his back pain will return. He is taught to sit with the hips "tucked under" and with the knees higher than the hips, and in driving to keep the seat forward to attain this position. He sleeps on a firm bed, not on his abdomen, but with the knees flexed lying on his side, or if on his back with a pillow under the knees. He is taught never to lift weights above his elbows, and to rest one foot on a stool when standing. He always keeps his low back flat. At home he leans against a wall or door attempting to touch the entire lumbar spine. A very useful home treatment is to have the patient lie on his back with the hips and knees each flexed 90 degrees and the calves in the seat of a chair of suitable height. Much relief is obtained also by pulling the thighs up on the chest with the hands, while lying on the back, thus stretching the painful cramping muscles. Many years have passed since the conception that lordosis as such represents an unstable mechanical weakness in a spine. The medical profession has been slow to give up the old methods of treating backache in extension. Correction of sway back is mandatory in low back pain. Our experience in the past four years has given convincing evidence that the flexion treatment will relieve a high percentage of low back pain.

Tendinitis and Subacromial Bursitis. K. Armand Fischer, and Kenton D. Leatherman.

J. Kentucky M. A. **49**:296 (July) 1951.

Conservative treatment usually suffices in the ordinary case of acute tendinitis and subacromial bursitis. Sedation is necessary because most patients have considerable pain and loss of sleep. The usual patient keeps his arm adducted to his side in order to splint it, and a measure which will relieve pain quickly is the placing of the arm on pillows away from the chest at 90 degrees or placing the arm on an abduction splint. Frequently this relieves pain in itself. Hot moist packs seem to be most beneficial for relief of pain and one should use them whether a patient is in bed or wearing an abduction splint, or keeps his arm abducted on the side of the bed or table. In very painful cases hot moist packs should be kept on 24 hours a day except when certain exercises are taken. In ambulatory cases that have mild pain, procaine injections of one or two per cent solution into the region of the bursa will temporarily relieve this pain and then circumduction and pendulum exercises can be started in order to bring about a complete range of motion in the shoulder. These exercises should be done hourly. Aspiration and needling of a calcium deposit after injection of procaine is another popular method of treatment. After such an irrigation a shoulder manipulation should be done and the patient given instructions in circumduction exercises. This type of treatment is best carried out in a hospital because the pain returns after the needling and the patient should be near where plenty of sedation can be given. Cold packs are used for 24 hours and this should be followed by moist hot packs and the exercising routine. An exercise routine should be used in every case no matter what type of treatment has been used, and when resting, the arm should be placed in abduction, either on a splint or pillow. Pendulum exercises are easy to do and they are not contraindicated in any type of bursitis. After a few trials then the patients can do circumduction exercises and one should instruct them that the more they do them the sooner they will lose the pain. In the sitting position we try to have them put their hand behind their head to improve external rotation of the shoulder, and when standing they should place their hand behind their back for internal rotation of the arm. X-ray therapy is beneficial to acute cases and some subacute cases. So often with the use of x-ray therapy the patient is not given exercises or hot packs. It is very necessary to use some type of heat and exercises following X-ray therapy or stiffness of the shoulder may ensue in spite of relief of pain. The acute symptoms of bursitis usually pass away in from 5 to 7 days and even after that the exercise routine must be kept up and the arm be abducted on a pillow while in bed. It usually is necessary to continue the circumduction exercises, placing the hand behind their head and behind their back for a period of several months time. It is well after the first week to use some dry heat in the form of infrared ray on the shoulder before exercising when possible. Until a normal range of motion has been established in the shoulder, exercises and even stretching of the tight shoulder is necessary. Surgery is indicated in some cases of acute tendinitis with subacromial bursitis. At the time of surgery the shoulder is manipulated in all directions, and following the operation the arm is placed in an abducted position.

Treatment of these hospital patients must be continued for several months following the manipulation. They should be in the hands of a competent physical therapist and the physician should see them almost daily to impress upon them the necessity of hourly exercises and a heat routine at home. The more chronic patients will have the exercise sometimes for a period of 6 to 12 months before a complete range of motion has returned and the pain in the neck, hand and arm is relieved.

Physiological Responses of Men to Chilling in Ice Water and to Slow and Fast Rewarming. A. R. Behnke, and C. P. Yaglou.

J. Appl. Physiol. 3:591 (Apr.) 1951.

Two nude subjects were immersed shoulder-deep in ice water for about one hour until the toes became numb, then the exposure was terminated. The average water temperature varied from about 42 F. in the winter to as high as 50 F. in the summer. Following this drastic chilling the subjects were rewarmed by exposure to air at 73 to 100 F. or to water at 100 to 102 F. A third subject dressed in outdoor winter clothing was chilled in a cold chamber at —20 F. for about 3 hours, until his toes became numb. He was then rewarmed in air at 100 F. without changing clothes. Skin temperatures fell abruptly upon entering the cold bath, and the subjects experienced excruciating pains all over the body during the transitory period of vasoconstriction. Rectal, gastric and oral temperatures after an initial rise fell continuously during the chilling period, despite violent shivering and a sixfold increase of metabolic rate. In rewarming of chilled subjects, skin temperatures rose abruptly, while deep temperatures continued falling for some time at a rate that was even greater than that during the preceding immersion period. A second cold shock was experienced during the first stage of rewarming which was even more distressing than the initial immersion shock. Its duration depended on the rapidity of rewarming. Rewarming in air at 70 to 100 F. consumed several hours, and unnecessarily prolonged the agony from shaking chills. Best results were obtained by rapid rewarming in water at 100 to 105 F. Under the conditions of our experiments, the need for rapid rewarming to prevent a precipitous after-drop of deep temperatures, and associated distress, is imperative.

The Prevention of Thromboembolism. Leo Loewe, and Richard P. Lasser.

Angiology 2:26 (Feb.) 1951.

This communication is intended to discuss the problems of thromboembolic disease in general; to review, critically, the various measures now employed in dealing with the disease and to recount our experience with a comprehensive prophylactic program. This will serve to emphasize the importance of a prophylactic approach rather than a purely therapeutic one and will demonstrate that a large scale prophylactic effort is both fruitful and feasible. Several non-specific measures in the prevention of venous thromboembolic disease are used generally, in surgical patients. One of these is early ambulation. This means not merely dangling but actually getting the patient out of bed. The heels, only, are to be supported by a soft foot stool. The calves should not be in contact with anything; in other words, there should be an avoidance of pressure on the calf veins. Patients should actually be ambulated on the day of operation and preferably immediately or as soon after the operation as possible. This can be done, with but few exceptions. It is an erroneous idea that patients who are merely gotten out of bed and permitted to sit for an undetermined period of time are ambulated. This, in point of fact, is worse than permitting the patient to be in bed throughout. Early ambulation is associated with a reduction in the incidence of thromboembolic disease from 53 to 18 per cent and especially is the incidence of pulmonary embolism reduced. These statistics may be, of course, somewhat overenthusiastic in that many of the reported series do not take into consideration the delayed type of thromboembolic disease which makes its appearance after the patient's discharge from the hospital. We know of instances of this type, and are convinced that others have encountered the same. While early ambulation alone does not solve the problem in its entirety, the fact, nevertheless, remains that both the morbidity and the mortality are decidedly reduced. Elevation of the legs and leg exercises are helpful but the beneficial effects are not too significant.. Exercises in bed are nevertheless recommended.

Avoidance of compression of calf veins, especially in elderly subjects, is an important detail. This applies to the procedures in the operating room as well as postoperatively. In patients with varicose veins, elastic stockings and other pressure dressings are of some value. However, severe compression of varicose veins in elderly subjects is contraindicated. Such general measures can be carried out regularly except in the aged, the desperately ill, those with advanced malignancy and the bed-fast.

Administrative Problems in a Polio Unit. Sister M. Assumpta.

Hosp. Progr. 32:170 (June) 1951.

In considering facilities for convalescent care, we should discuss the use of physical therapy facilities such as exercise tables, practice mats, parallel bars, training steps, crutches or walking sticks, wall mirrors, etc. In other words, an administrative problem of the hospital would be to provide the space for this equipment, allowing ample room for its appropriate use. Some hospitals might make provision for the Hubbard tank or other type of treatment pools, although these are not always necessary. An ordinary bathtub could be used in the convalescent ward. One physical therapist usually can take care of about six acutely ill polio patients but there is wide latitude depending upon the severity of involvement. If there is not too much involvement, a physical therapist will be able to take care of more patients during the acute stage. During convalescence, a physical therapist can take care of approximately 12-15 patients in a ward. One physical therapist can take care of 15 to 20 out-patients daily, depending upon the amount of involvement they have. Obviously, when complete muscle

evaluations are done, the number will be less. These figures are necessarily flexible and, unfortunately, all too often a heavy case load increases the burden on any individual therapist beyond the desired ratio. Under therapeutic services, we should discuss the treatment of the patient during the acute phase of the illness with the proper use of nursing, physical therapy, hot packs, warm pools, respirators, rocking bed, etc. It should be remembered that there is nothing magic or curative about the hot packs. The degree of remaining muscle paralysis depends upon the number of anterior horn cells (motor nerve cells) that are destroyed by this virus. It is acknowledged that moist heat, either in the form of hot packs or warm pool treatments, does relieve muscle pain and when this is accompanied or followed by gently passive and later active exercises, the flexibility of muscles and joints is maintained more easily. Naturally, heat should not be applied while the patient is still running a high fever, but should be started as promptly as possible. Hot packing should be cautiously used on weakened patients during hot weather. The roles of the occupational therapist, medical social worker, and public health nurse should also be discussed. Special treatment should be given to the bulbar type patient, stressing pastural drainage, aspiration, etc. All convalescent patients with muscle involvement should have functional training and rehabilitative training. This should be done by a physical therapist in the out-patient department or in the hospital's therapy department.

The Blood Flow to the Lower Limbs in Peripheral Arterial Disease and Coarctation of the Aorta. G. M. Wilson.

Edinburgh M. J. **58**:125 (March) 1951.

A plethysmograph suitable for use on the foot has been described and has been used for the measurement of blood flow in normal subjects and in those with peripheral arterial disease and coarctation of the aorta. The maximal blood flow determined with the plethysmograph water bath at 43 degrees was investigated in 33 normal subjects. The mean blood flow was 20.5 ml./min./100 ml. After the age of 30 years there was a steady decline in the maximal blood flow. A similar investigation of 17 cases of intermittent claudication affecting the calf muscles showed that in the majority there was a considerable reduction in the blood flow to the foot. The effect of elevating the foot of the couch on which the subject was lying to an angle of 7 degrees was investigated. In normal subjects this caused approximately a 25 per cent reduction in the maximal blood flow to the foot. The reduction was less in patients with hypertension but with intact peripheral arteries. In peripheral arterial disease the decrease on elevation was considerably greater than in a normal limb. The maximal blood flow in the foot was measured in six cases of coarctation of the aorta and fell within the normal range. In one case the stricture lay between the origins of the arterial supply to the upper limbs but the blood flow to the left hand, delivered by arteries arising beyond the site of the coarctation, was not reduced.

Treatment of Rheumatoid Arthritis: An Appraisal of Some Currently Used Methods. Edward W. Boland.

Am. Pract. **2**:577 (July) 1951.

Most chronic diseases serve as trying therapeutic problems but probably none has been more challenging than rheumatoid arthritis. Because the clinical pattern of the disease is variable and often unpredictable, and because response to treatment with measures used in the past has been slow, appraisal of newly recommended agents has been difficult. With an unknown pathogenesis and without the advantage of employing experimental animals to evaluate therapy, treatment has been almost entirely empirical. For no other disease have so many remedies been proposed, and although often heralded by extravagant claims, most have proved eventually to be of limited or no value. However, the proper selection of certain time-tested measures has made it possible to afford varying degrees of comfort and often to prevent crippling — indeed, not infrequently therapeutic effort has been rewarded by partial or complete arrest of the disease. One of the measures designed to alleviate discomfort and to prevent deformities is physical therapy. Proper home physical therapy measures with the use of relatively simple apparatus (radiant heat, contrast baths, hot packs, paraffin baths, hot tub baths, sponge rubber finger exercises, quadriceps drill exercises, muscle massage, rotary and abduction exercises for the shoulders, etc.) are of distinct value. These can easily be taught to the patient and/or members of his family and can be carried out once or twice daily; they may be supplemented advantageously by professional physical therapy two to three times a week when necessary. Simple plaster splints, worn at night and intermittently during the day, may be of value in preventing deformities and should be employed early while medical measures are being instituted. One must, however, guard against prolonged splinting, as such may promote stiffness of the joints and atrophy of the muscles. Even during acutely painful stages plaster molds must be removed daily and passive motion allowed. In the treatment of rheumatoid spondylitis the prevention of postural deformity constitutes a special problem. The patient should be taught how to assume the proper stance at all times with the lower abdominal muscles pulled in, the thorax raised, the shoulders squared and the head held erect. In addition, he should be taught trunk stretching exercises, hamstring and calf-stretching exercises, deep breathing exercises, and exercises for the correction of special postural defects. He should perform these exercises twice daily at home. Analgesics such as aspirin taken beforehand will often allow the patient to carry them out more

enthusiastically, and a hot tub bath beforehand also will help. The patient should be instructed in the use of a firm bed without pillows and a blanket roll beneath the thoracic spine for spinal hyperextension. In most instances, if proper exercises are begun early, orthopedic braces are not necessary at later stages.

Present and Future Plans for the Rehabilitation of Patients in General Hospitals — II. Nila Kirkpatrick Covalt.

Mod. Hosp. **76**:96 (May) 1951.

Physical medicine basically comprises the two divisions of occupational therapy and physical therapy. The minimum equipment and space for physical therapy in any hospital containing up to 300 beds is eight treatment tables in 8 by 8 foot cubicles. Ideally, there should be treatment rooms with a large adjoining gymnasium. A gymnasium is more important at the start of a program than is the treatment room containing treatment tables and the various modalities used in physical medicine, particularly when no physiatrist is available. Many exercises are best given on mats, where patients can do more exercises with a more nearly complete range of motion and without the fear of falling, which they have on a table. Progressive exercises such as crawling or short crutch walking, can be done only on mats. Functional training in "Activities of Daily Living," walking retraining, and crutch walking are based upon a sound knowledge of kinesiology. This knowledge of muscle action is the basic knowledge for physical therapists particularly, and to only a slightly lesser extent for occupational therapists. Because of this specialized training, it is easier for therapists to retrain patients than it is for individuals without such knowledge to do the training. However, these procedures are not so specific as definitive muscle reeducation and proper choice of many therapeutic exercises which therapists must do. Hence, a physical therapist can teach the principles of crutch walking and functional training to any interested nurse, other hospital personnel, or to relatives. Therapists can also give instruction in correct bed positioning. Lantern slides and movies are available on loan from various sources which show some of the techniques. If it is impossible for a hospital to hire a qualified physical therapist, there are therapists probably available in most states who can be called in as consultants to help train the hospital personnel. Sometimes therapists are employed in various sections of state departments of health and the state would be willing to loan them. If it is impossible to complete all training in self-care activities without the use of braces, then they too should be provided. Early bracing and attention to the details of bracing are important aspects of rehabilitation and are the physicians' problems. Training in their use (including putting the braces on and taking them off) are therapists' and nurses' problems. Walking reeducation with prostheses is the therapists' problem.

Recent Experiences in the Treatment of War Wounds of the Chest. Hu A. Blake; Samuel P. Wise, III; Vann S. Taylor; Stephen L. Kylar; Robert C. Major, and James H. Forsee.

U. S. Armed Forces M. J. **2**:861 (June) 1951.

The combined efforts of the thoracic surgeon, internist, physiatrist, and the endoscopist emphasizing pulmonary function made thorough evaluation of each patient possible. The physiatrist deals with the prevention of chest deformity and restoration of function. In a number of patients with borderline indications for decortication, improvement in pulmonary function following selective pressure-expansion exercises was such as to obviate operation. Selective breathing exercises were started early and vital capacity was recorded weekly. This form of predominantly unilateral breathing became virtually automatic with the patient in the preoperative phase so that postoperative maintenance of a mobile chest wall and diaphragm were greatly facilitated. In the immediate postoperative phase pressure-expansion exercises were begun on the ward. Proper bed positioning and assistance in shoulder motion exercises were cared for by the physical therapist. Breathing exercises for 5 minutes of each hour and shoulder exercises at 3 hour intervals were accomplished. Frequent coughing was encouraged Seven to 10 days after operation and following removal of the sutures the patient was followed in the Physical Medicine Clinic with individual instruction and group participation, each once daily. Friction massage was applied to free the tissues in the region of the surgical scar. When satisfactory status was obtained, the patient was sent to the physical reconditioning gymnasium for continued group therapy and by from 21 to 30 days after operation, he was fully rehabilitated and ready for convalescent furlough. He was carefully instructed as to the importance of continuing pressure expansion exercises while at home.

Physical Medicine in Thyroid Disorders. George H. Dobney.

Clin. J. **60**:158 (June) 1951.

Increased vascularity of the thyroid may result from any form of heating or counter-irritation applied to the neck. Diathermy, owing to its effect in heating deeper tissues and increasing the circulation, should be avoided if possible in the regions of the neck and shoulder. If any heat is advised in treatment of fibrositis of the neck, which frequently occurs in hyperthyroidism, long wave infrared, which has a very poor penetrating power through the skin, should be used.

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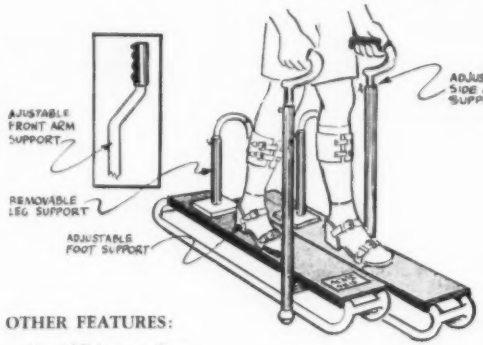

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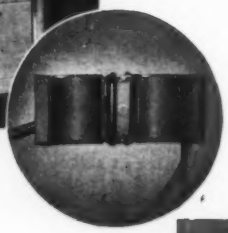

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Letterman Army Hospital★	San Francisco	A. E. White	3,330	74,961	....	....	.....
Fitzsimons Army Hospital★	Denver	H. B. Luscombe	19,403	258,913	1	4	.....
Army Medical Center★	Washington, D. C.	J. H. Kuttert	6,755	263,456	3	5	.....
VETERANS ADMINISTRATION							
Veterans Admin. Hospital★[1]	Long Beach, Calif.	R. N. Nyquist	10,922	195,816	1	2	.....
†Veterans Admin. Hospital[1]	Fort Logan, Colo.	F. J. Fricke	907	36,326	....	....	.....
Veterans Admin. Hospital	Hines, Ill.	L. B. Newman	5,665	450,711	....	....	.....
Veterans Admin. Hospital[1]	Wadsworth, Kans.	L. Blau	3,169	192,760	....	....	.....
Veterans Admin. Hospital[1]	Framingham, Mass.	F. Friedland	7,000	210,000	1	3	.....
Veterans Admin. Hospital[1]	Jefferson Bks., Mo.	E. H. Weissenb'g	2,215	77,491	1	1	.....
Veterans Admin. Hospital[1]	New York City	A. S. Abramson	13,819	314,026	3	9	.....
Veterans Admin. Hospital[1]	Cleveland	H. T. Zankel	6,414	81,929	1	1	.....
†Veterans Admin. Hospital	Portland, Ore.	E. W. Fowlks	4,954	110,420	1	1	.....
†Veterans Admin. Hospital[1]	Aspinwall, Pa.	S. Machover	2,516	106,131	....	1	.....
Veterans Admin. Hospital★[1]	Houston, Tex.	B. L. Boynton	1,582	6,394	1	1	.....
NONFEDERAL							
Los Angeles County Hospital★[1]	Los Angeles	E. Austin	.....	91,836	....	1	165
White Memorial Hospital★	Los Angeles	F. B. Moor	195	.....	1	1	120
University of Colorado Medical Center Colorado General Hospital★[1]	Denver	H. L. Dinken	2,580	45,876	1	3	75
State of Connecticut Vet. Home & Hosp.	Rocky Hill, Conn.	.....	.....	.....	3	3	.....
Emory University Hospital★	Emory Univ., Ga.	R. L. Bennett	1,719	10,473	1	1	50
Georgia Warm Springs Foundation	Warm Springs, Ga.	R. L. Bennett	973	104,401	1	3	250
Cook County Hospital★[1]	Chicago	D. Kobak	7,501	37,516	....	....	.....
Michael Reese Hospital★[1]	Chicago	C. O. Molander	2,254	19,589	1	1	25
Northwestern University Medical Center	Chicago	.....	13,590	40,962	....	....	.....
Research and Educational Hospitals★[1]	Chicago	H. W. Kendell	5,688	11,769	1	3	55
University of Kansas Medical Center★[1]	Kansas City, Kans.	D. L. Rose	2,456	42,310	1	1	100
Massachusetts General Hospital★	Boston	A. L. Watkins	2,925	31,999	0	9	41.66
University Hospital★	Ann Arbor, Mich.	.....	.....	.....	....	....	.....
University of Minnesota Hospital★[1]	Minneapolis	M. Knapp	20,409	29,436	4	4	.....
Mayo Foundation	Rochester, Minn.	F. H. Krusen	.....	.....	2	6	135
Barnes Hospital★	St. Louis	S. Mead	9,759	9,759	0	1	.....
†Bellevue Hosp., Div. III, N. Y. Univ.★[1]	New York City	H. A. Rusk	4,058	116,705	....	7	80
Goldwater Memorial Hospital★	New York City	M. Dacso	733	50,706	1	2	80
Hospital for Joint Diseases★[1]	New York City	J. Weiss	.....	94,631	1	1	40
Hospital for Special Surgery	New York City	K. G. Hansson	20,806	40,810	1	1	160
Mount Sinai Hospital★[1]	New York City	W. Bierman	11,942	36,970	1	1	50
New York City Hospital★[1]	New York City	F. K. Safford, Jr.	1,138	41,088	1	1	130
†Presbyterian Hospital★[1]	New York City	W. B. Snow	35,865	103,546	1	1	208
St. Luke's Hospital★[1]	New York City	R. Muller	900	98,954	1	1	60
†Rehabilitation Hospital	W. Haverstraw, N. Y.	M. Hoberman	5,868	408,371	1	1	225
Cleveland Clinic Hospital[1]	Cleveland	S. G. Gamble	17,062	38,475	1	4	.....
Hospital of the University of Pa.★[1]	Philadelphia	G. M. Piersol	1,636	35,639	0	1	.....
Philadelphia General Hospital★[1]	Philadelphia	A. A. Martucci	2,827	23,733	1	1	75
Medical College of Virginia—Hosp. Div.★[1]	Richmond, Va.	W. J. Lee	4,575	40,327	....	....	46.50

The star (★) indicates hospital approved for intern training.
The dagger (†) indicates temporary approval.
[1] Residencies open to women.
** Reprinted in part J. A. M. A. 147:140 (September 29) 1951.

APPROVED SCHOOLS OF OCCUPATIONAL THERAPY **

Council on Medical Education and Hospitals of the American Medical Association

Name and Location of School	Director and Medical Director	Entrance Requirements	Duration of Course[1]	Classes Begin	Graduates in 1950	Tuition per Year	Certificate, Diploma, Degree
University of Southern California, Los Angeles*	Margaret S. Rood	Degree	18 mos.	Varies	12	$584	Certificate
	I. B. Armstrong, M.D.	High sch.	5 yrs.	Varies	19	$540	Cert. & Deg.
Mills College, Oakland, Calif.	Elsa H. Hill	Degree	2½ yrs.	FebSept	2	$250	Certificate
	S. M. Dorinson, M.D.	High sch.	5 yrs.	FebSept	4	$650	Cert. & Deg.
San Jose State College, San Jose, Calif.*	Mary D. Booth	Degree	18 mos.	Varies	1	$ 28.50	Certificate
	Charles Ianne, M.D.	High sch.	45 mos.	Varies	13	$ 28.50	Cert. & Deg.
University of Illinois College of Medicine, Chicago*	Beatrice D. Wade	High sch.	5 yrs.	MarSept	13	$110	Degree
	S. W. Olson, M.D.						
State University of Iowa, Iowa City*	Marguerite McDonald		19 mos.	FebSept	2	$144[2]	Certificate
	W. D. Paul, M.D.	High sch.	46 mos.	FebSept	5	$144[2]	Cert. & Deg.
University of Kansas, Lawrence	Nancie B. Greenman	High sch.	45 mos.	FebSept	16	$138[2]	Degree
	D. L. Rose, M.D.						
Boston School of Occupational Therapy, 7 Harcourt St., Boston*	Marjorie B. Greene	Degree	2 yrs.	Sept	13	$500	Diploma
	A. W. Reggio, M.D.	High sch.	5 yrs.	Sept	21	$500	Degree
Wayne University, Detroit*	Barbara Jewett	Degree	19 mos.	Varies	1	$150	Certificate
	F. A. Weiser, M.D.	High sch.	46 mos.	Varies	2	$150	Degree
Kalamazoo School of Occupational Therapy, Kalamazoo, Mich.*	Marion R. Spear	Degree	18 mos.	FebSept	3	$ 75[2]	Diploma
	R. B. Burrell, M.D.	1 yr. coll.	4 yrs.	FebSept	23	$ 75[2]	Dipl. & Deg.
Michigan State Normal College, Ypsilanti, Mich.*	Frances Herrick	High sch.	5 yrs.	FebSept	6	$ 67.50[2]	Cert. & Deg
	V. L. VanDuzen, M.D.						
University of Minnesota, Minneapolis*	Borghild Hansen	High sch.	40 mos.	Sept	12	$128[2]	Degree
	F. J. Kottke, M.D.						
College of St. Catherine, 2004 Randolph, St. Paul	Sister Jeanne Marie	High sch.	4½ yrs.	Varies	24	$225	Degree
	I. M. Ryan, M.D.						
Washington University School of Medicine, St. Louis*	Erna L. Rozmarynowski	Degree	11-14 mos.	Sept	—	University	Certificate
	R. A. Moore, M.D.	2 yrs. coll.	28 mos.	Sept	14	University	Degree
University of New Hampshire, Durham*	Esther Drew	High sch.	5 yrs.	Sept	8	$200[2]	Cert. & Deg.
	I. A. MacDonald						
Columbia University College of Physicians and Surgeons, New York City*	Marjorie Fish	Degree	17 mos.	Sept	20	$600	Certificate
New York University School of Education, New York City*	W. B. Snow, M.D.	2 yrs. coll.	27 mos.	Sept	10	$600	Degree
	Frieda J. Behlen	1 yr. coll.		FebSept	3	$500	Certificate
Ohio State University, Columbus*	John Sawhill, M.D.	High sch.	4½ yrs.	FebSept	26	$500	Cert. & Deg.
	Martha E. Jackson	High sch.	4 yrs.	Varies	16	$ 90[2]	Degree
	R. H. Jacques, M.D.						
Philadelphia School of Occupational Therapy of the School of Auxiliary Medical Services of the University of Pennsylvania, Philadelphia*	Helen S. Willard	Degree	18 mos.	Sept	21	$600	Certificate
	I. C. Yaskin, M.D.	High sch.	5 yrs.	Sept	1	$600	Degree
Texas State College for Women, Denton	Fanny B. Vanderkooi	Degree	18 mos.	FebSept	—	—	Certificate
	O. T. Woods, M.D.	High sch.	5 yrs.	FebSept	5	$ 50	Degree
Richmond Professional Institute, 901 W. Franklin St., Richmond, Va.*	H. Elizabeth Messick	High sch.	4 yrs.	Sept	5	$200	Degree
	I. E. Barrett, M.D.	Degree	10-18 mos.	FebSept	4	$182+	Certificate
College of Puget Sound, 18th and Warner Sts., Tacoma, Wash.*	Edna-Ellen Bell		2 yrs.	FebSept	—	$400	Certificate
	A. J. Hermann, M.D.	High sch.	5 yrs.	FebSept	5	$350	Cert. & Deg.
University of Wisconsin, Madison*	Caroline G. Thompson	High sch.	5 yrs.	Sept	12	$120[2]	Cert. & Deg.
	H. D. Bouman, M.D.						
Milwaukee-Downer College, Dept. of Occupational Therapy, 2512 E. Hartford Ave., Milwaukee	Henrietta W. McNary	2 yrs. coll.	3 yrs.	Sept	2	$350	Diploma
	M. C. Borman, M.D.	High sch.	5 yrs.	Sept	20	$350	Dipl. & Deg.
Mount Mary College, 92d and Burleigh, Milwaukee	Sister Mary Arthur	High sch.	5 yrs.	Sept	14	$360	Cert. & Deg.
	J. C. Griffith, M.D.				—		

** Reprinted J. A. M. A. 146:198 (May 12) 1951.

1. Duration of course is expressed in academic years or in number of months.

2. Nonresidents charged additional fee.

* Male as well as female students admitted.

MEETINGS OF INTEREST TO THOSE IN THE FIELD OF PHYSICAL MEDICINE AND REHABILITATION

In this column will be published information about meetings of interest to those in the field of physical medicine. New data should be sent promptly to the office of the ARCHIVES, 30 North Michigan Avenue, Chicago 2, Illinois.

International

International Congress of Physical Medicine (1952). London, July 14 to 19, 1952. Applications for the provisional program should be addressed to the Honorary Secretary, Dr. A. C. Boyle, International Congress of Physical Medicine (1952) 45, Lincoln's Inn Fields, London, W.C. 2.

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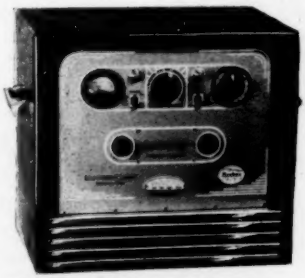

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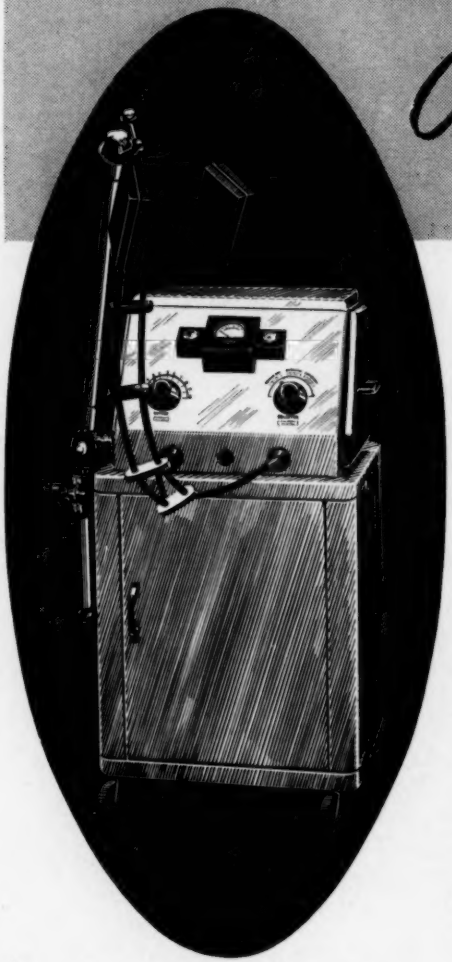

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